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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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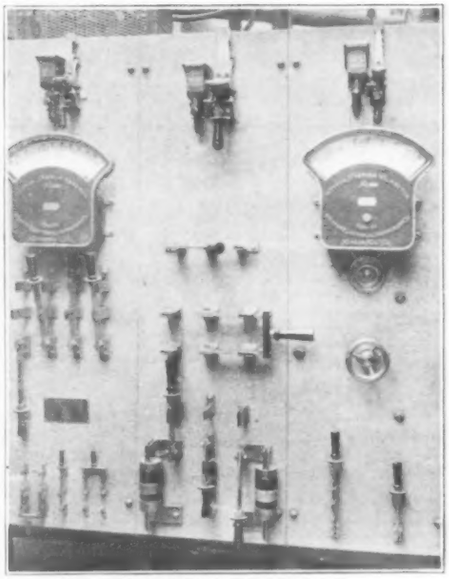

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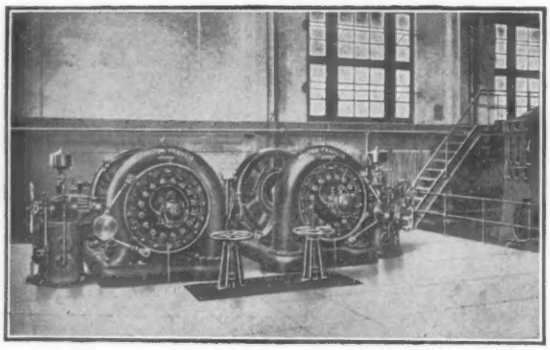

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The Pacific Gas and Electric Company

Supplies Light, Heat, and Power

TO

Place	Population.
Agua Caliente	50
*Alameda	27,000
**Albany	800
††Alta	200
Alvarado	200
Amador	200
Antioch	3,000
††Auburn	2,050
Barber	200
**Belmont	600
Belvedera	350
Benicia	2,500
**Berkeley	42,000
Big Oak Flat	150
Biggs	750
Black Diamond	500
Brentwood	200
Brighton	100
Broderick	500
‡Brown's Valley	50
**Burlingame	5,000
Byron	200
Campbell	1,000
Cement	1,500
‡Centerville	20
Centerville	500
**Chico	13,000
**Colusa	2,700
†Colfax	400
Colma	500
Concord	1,500
Cordelia	150
Corte Madera	350
Crockett	2,500
Crow's Landing	375
Davenport	1,000
Davis	750
Decoto	350
Dixon	1,000
Dobbins	50
Drytown	100
Durham	500
‡Dutch Flat	400
**Easton	500
**East San Jose	1,500
Eckley	20
Emerald	50
Elmhurst	2,500
Elmira	150
El Verano	100
**Emeryville	2,000
Encinal	20
Fairfield	800
**Fair Oaks	250
Fitchburg	250
Folsom	1,500
*Fresno	35,000
Glenn Ellen	500
Gold Run	100
Grafton	350
†Grass Valley	7,000
Gridley	1,800
Groveland	50
Hammonton	500
Hayward	4,000
Hollister	3,000
Ione	900
Irvington	1,000
Jackson	2,000
Jackson Gate	50
Larkspur	950
Lawrence	100
Kennedy Flat	50
Kentfield	200
‡Lincoln	1,500
†Live Oak	200
Livermore	2,250
‡Loomis	150
Los Altos	200
Los Gatos	3,000
Mare Island	500
Martell	25
Martinez	5,000
**Marysville	6,250
Mayfield	1,500
**Menlo Park	1,500
Meridian	300
**Millbrae	300
Mill Valley	4,500
Mission San Jose	500
Mokelumne Hill	150
Mountain View	2,500
**Napa	6,000
†Nevada City	4,000
Newark	700
‡Newcastle	600
New Chicago	25
Newman	1,000
Niles	800
**Oakland	230,000
Oroville	2,500
Orwood	50
Pacheco	200
**Palo Alto	6,000
†Penryn	250
Perkins	200
**Petaluma	6,000
Peyton	250
**Piedmont	2,000
Pinole	1,500
Pleasanton	2,000
Port Costa	600
**Redwood City	3,500
Richmond	10,000
Rio Vista	200
‡Rocklin	1,050
Rodeo	100
†Roseville	345
Ross	900
***Sacramento	52,000
San Andreas	200
San Anselmo	2,500
San Bruno	1,500
San Carlos	100
**San Francisco	450,000
**San Jose	40,000
San Leandro	4,000
San Lorenzo	100
**San Mateo	7,000
San Pablo	1,000
**San Quentin Prison	1,600
**San Rafael	6,000
Santa Clara	8,000
Santa Cruz	10,000
**Santa Rosa	8,000
Saratoga	200
Sausalito	3,000
Sebastopol	2,000
Selby	100
Sonoma	1,200
South San Fran	2,500
Stanford University	2,000
Stege	100
‡Stockton	25,000
Suisun	1,200
Sunnyvale	2,000
Sutter Creek	2,000
Tiburon	100
Tormey	150
‡Towle	200
Tracy	1,200
Vacaville	2,500
**Vallejo	12,000
Vallejo Junction	10
Walnut Creek	350
Wheatland	1,400
Winters	1,200
**Woodland	3,500
Yolo	350
**Yuba City	1,900

*Gas only; **gas and electricity; †electricity, gas, and water; ‡electricity and water; ***gas, electricity, and street car service; all others, electricity only.

Service Furnished	Number of Towns	Total Population
Electricity	158	1,089,790
Gas	33	988,900
Water	17	43,415
Street Car	1	52,000

EMPLOYS 3,500 people

OPERATES 11 hydro-electric plants in the mountains

3 steam-driven electric plants in big cities.

18 gas works

SERVES ⅔ of California's population

26 of California's 56 counties

An area of 32,431 square miles

3/5 the size of New York state

½ the size of all the New England states combined

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVII SAN FRANCISCO, SEPTEMBER 9, 1911 NUMBER 11

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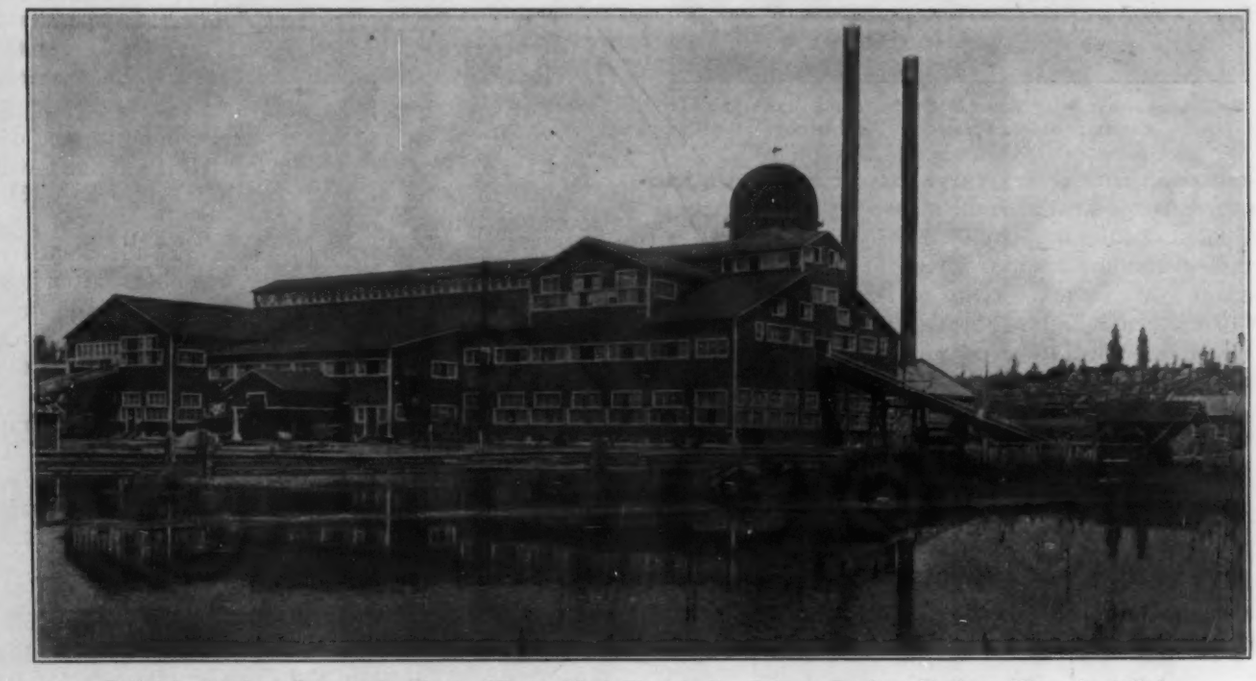
ELECTRICALLY DRIVEN DONKEY ENGINES

BY AUGUST WOLF.

Donkey engines driven by electricity are the latest features of modern logging operations in the Spokane district and it is planned to extend their use to forests in other parts of the Pacific Slope and intermountain country. It is predicted by engineers that the electrification of logging roads naturally will follow the adoption of electric logging on a large scale. The advantages claimed are the elimination of fire risk, the ease of power transmission and the use for large quantities of wood, now destroyed as refuse by many lumber mills in the Northwest.



Potlatch Lumber Company's Plant, Where First Electrically Driven Donkey Engines Were Installed.

The first electric donkey engines to be used in the Northwestern forests are at Potlatch, Idaho. They are built on lines originating by E. J. Barry, electrical engineer of the Potlatch Lumber Company, who, for experimental purposes, converted a steam donkey machine by gearing the motor to the position formerly occupied by the boiler. A motor-driven compressor supplies air for the signal whistle. The apparatus, specially built for severe service, is a 150-h.p., 3-phase, 550-volt, 60-cycle, 435-r.p.m. motor, equipped with a current limiting device. The engine handles an average of 35,000 feet of logs a day. Ten engines to handle from 300,000 to 500,000 feet a day will be installed to replace steam engines.

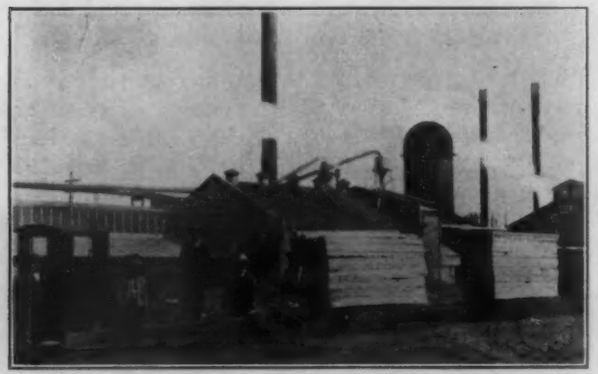
Should the tests of the Potlatch Lumber Company prove successful it will be necessary to step up the present voltage of 550 to a pressure which will allow of transmission over a large area. Transformers for this purpose, giving two voltages of 11,000 and 22,000 volts respectively, according to connection, will be used; 11,000 volts will be used till the requirements exceed economical transmission at this pressure, when a change will be made by reconnecting the transformers for 22,000 volts. This will allow a 20-mile radius for power transmission.

In operating motors it will be necessary to have the supply wires taken over ground from which the standing timber has been cleared, owing to the danger of interrupted service through trees falling on the

line. This will be arranged by having the transmission lines always in the rear of the logger and consequently built over logged-off land. A portable sub-station consisting of one 3-phase transformer of 150 kilowatt capacity will be placed at a convenient point for stepping down the voltage from 11,000 to 550.

From the sub-station a 3-core steel armored cable will run to the motor on the logger, this cable being supplied in sections to allow the logger being warped out up to a distance of 1800 feet from the sub-station. Mr. Barry is confident that within its capacity a motor will do all expected of it and still have a good reserve fund of energy for overloads.

Regarding the electrification of logging roads, it is found that the first cost of an electric road is high in



Transportation of Lumber From Mill to Yard by Electric Storage Battery Locomotive.

comparison with steam, varying from two and a half to three times in initial outlay, owing to the expense of poles, insulators, trolley lines, transformers, rail bonding and the labor involved in installing the apparatus. Maintenance costs are less, varying from 8 to 10 per cent. Delays through breakdowns have decreased one-third since adopting electric drive on a road previously operated by steam. The average cost of electric locomotives is from $11,000 to $16,000, dependent on size and capacity, about the same as for steam locomatives.

Probably the greatest advantage of electric drive is the fact that a use may be found for the large quantities of fuel now burned uselessly as refuse by every lumber mill. Many thousands of horsepower are thus wasted every year, and it is surely time, in this era of conservation, to try to reduce this loss to a minimum, and much credit is due to the Potlatch Lumber Company's officials for their pioneer service in this line of power use.

FAR EASTERN NEWS.

The waterworks and electric-light company at Newchwang has been taken over by the South Manchuria Railway Co.

The projectors of the Inawashiro Hydroelectric Power Co. have at length received a charter from the Government. The projectors are among the leading business men of Japan, namely, Baron Shibusawa, Mr. R. Kondo, and Mr. R. Toyokawa. Their idea is to obtain water from Inawashiro Lake, 50 miles from Tokyo, and they put their capital at $10,500,000.

PACIFIC COAST GAS ASSOCIATION.

The nineteenth annual convention of the Pacific Coast Gas Association will be held in Oakland, California, September 19, 20 and 21. Through the energy and enterprise of F. A. Leach, Jr., president of the association, and John A. Britton, secretary, not only the high standard of former conventions will be maintained but every indication points to a meeting even more entertaining and profitable than in the past. The following papers will be read at the convention:

President's Address.....Frank A. Leach, Jr.
1. Unstable Hydrocarbons in Illuminating Gas,. .....E. C. Jones
2. Suburban Gas Distribution....C. S. S. Forney
3. Rate Fixing.....Prof. C. L. Cory
4. The Napthalene Problem in Oil Gas, Manufacture and distribution.....F. S. Wade
5. Early Gas Lighting .....W. R. Morgan
6. Mechanical Handling of Carbon By-Product of the Oil Gas Process.....D. J. Young
7. The Gas Meter .....W. M. DuVal
8. (Title to be announced).....H. H. Jones
9. Wrinkles .....F. C. Millard
10. Experiences .....John D. Kuster
11. Novelties..... John Clement

The meeting will be held in Forester's Hall, S. E. Corner of 13th and Clay Streets, opposite the office of the Oakland Gas, Light & Heat Co., and will be called to order promptly at 10:00 o'clock A. M., September 19th.

Arrangements have been made with the Southern Pacific Company, whereby the members attending the Convention will be given a rate of one and one-third fare for the round trip (Receipt certificate plan), and which plan will be in force for the period from September 9 to 21.

The Banquet will be held in the Key Route Inn, on Wednesday evening, September 20th, at 7:00 o'clock and the outing, to be given by the Pacific Gas and Electric Company, will consist of a trolley trip in special cars, starting from the 22nd Street Terminus of the Key Route, at the Key Route Inn, at 9:30 o'clock Thursday morning, September 21st.

The cars will pass through Berkeley, Emeryville, Albany and Pullman, to Richmond, and, through the courtesy of the Standard Oil Company, a visit will be made to its great oil refineries at that point. The return trip will be made to Piedmont Park, via Oakland, where luncheon will be served at 1:00 o'clock P.M., after which the members will be given ample opportunity to visit the beautiful gardens and the extensive Art Gallery of Mr. F. C. Havens, which is located in the Park. On leaving the Park the route of the cars will be to San Leandro and Hayward, returning to Oakland via Alameda. The trip in all will afford the members a delightful outing, and also give them a conception of the scenic beauties of Alameda County. Headquarters for ladies during the Convention will be maintained at the Key Route Inn, where a Committee of Oakland ladies will be in attendance.

THE USE OF THE TRIPLE RATING OF INCANDESCENT LAMPS.

BY L. S. TWOMEY.

The function of any incandescent lamp is the production of light. The man purchasing a lamp is paying for an instrument for the production of light and not for a power consuming device. He is interested in the cost of the lamp only insofar as it effects the ultimate cost of producing light.

The cost of producing light is influenced by the cost of lamp renewals and the cost of energy. These factors in turn depend on the price of the lamp, the life of the lamp, the cost of energy per kilowatt-hour the power consumption of the lamp and its total luminous output. There is a relation between these items which determines the most economical operating conditions for a lamp for various costs of energy. The cost of the lamp divided by the hours life, divided by the luminous output of the lamp, gives the cost of lamp renewals per unit of light flux. The energy consumption per hour multiplied by the energy cost rate, divided by the luminous output, gives the energy cost per unit of light flux. The sum of these two costs is the true cost of light. The curves in Fig. 1, represent these costs graphically for any single cost of energy under varying operating conditions. The minimum point of the total cost curve represents the point of most economical operating conditions for that cost of power and for that particular lamp.

By burning the lamp at high efficiency, the power cost for a given amount of light may be decreased, but the renewal cost is increased. Computing the minimum cost of light for different energy rates it has been found that for low energy rates the lamp should be burned at low efficiency on high watts-per-candle, and that for high energy rates it should be burned at high efficiency with a corresponding sacrifice in life. In recognition of this fact the triple rating of incandescent lamps has been introduced.

By this method of rating three voltages are given on the label, the top voltage of which corresponds to the highest efficiency or lowest energy consumption per unit of light flux, and the bottom voltage corresponds to the lowest efficiency and longest life. In this way the customer with a high energy rate can order high efficiency lamps for his circuit and the customer with the low energy rate can order low efficiency lamps and thus approximate the most economical condition.

The accompanying tables have been computed to show the amount of light obtained per dollar expended for energy and lamp renewals. The darkened figures represent the most economical operation and show how this shifts from low to high efficiency as the energy rate increases. The unit of light flux which has been used is the lumen hour, which is that quantity of light

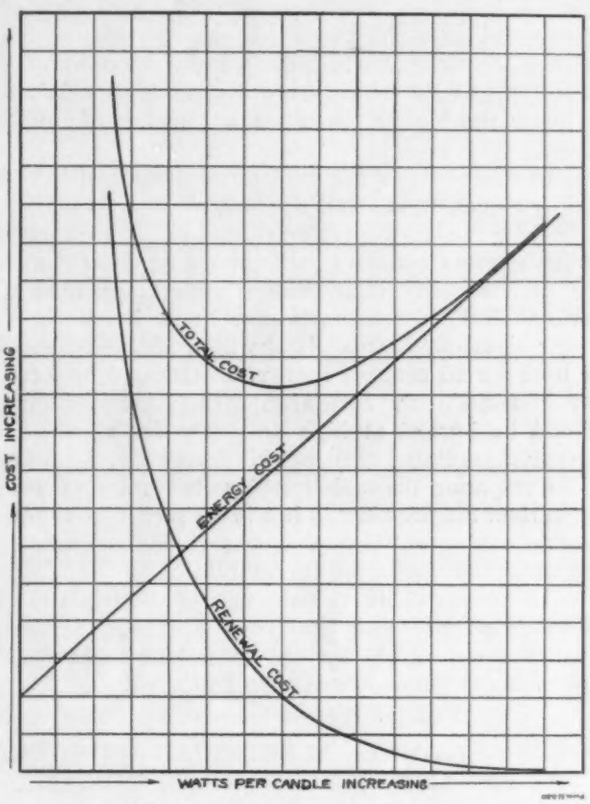


Fig. 1. Graphical Illustration of Lamp Costs for Varying Energy Costs and Operating Conditions.

which will illuminate an area of one square foot to the intensity of one foot candle for a period of one hour. The tables are given to show how the minimum cost of light shifts from low efficiency to high efficiency with increasing cost of energy and incidentally it

TABLE NO. 1.

Showing Cost of Producing Light with "Mazda" Lamps at "High," "Medium" and "Low" Efficiency.

Nominal Watts.	25			40			60			100		
Efficiency Step.	High.	Med.	Low.	High.	Med.	Low.	High.	Med.	Low.	High.	Med.	Low.
Variable Cost of Energy.	Thousands of Lumen-Hours obtained per dollar expended for Power and Lamp Renewals.											
1 cent per kw. hour	208.	232.	**203.**	294.	322.	**357.**	303.	345.	**370.**	357.	385.	**417.**
2 " " " "	161.	175.	**189.**	213.	227.	**238.**	222.	238.	**250.**	250.	256.	**270.**
3 " " " "	133.	141.	**147.**	170.	175.	**179.**	175.	185.	**189.**	192.	196.	**200.**
4 " " " "	114.	118.	**122.**	139.	141.	**145.**	145.	149.	**152.**	156.	156.	**159.**
5 " " " "	98.	101.	**103.**	119.	119.	**120.**	123.	**127.**	**127.**	**131.**	**131.**	**131.**
6 " " " "	87.	89.	**90.**	103.	103.	**104.**	108.	**109.**	**109.**	**114.**	113.	111.
8 " " " "	70.	71.	**71.**	**82.**	81.	81.	**86.**	**86.**	85.	**89.**	88.	86.
10 " " " "	**59.**	**59.**	**59.**	**68.**	67.	66.	**71.**	70.	69.	**74.**	71.	70.
12 " " " "	**51.**	**51.**	50.	**58.**	57.	56.	**61.**	60.	59.	**63.**	61.	59.

TABLE NO. 2.

Showing Cost of Producing Light with Carbon Lamps at "High," "Medium" and "Low" Efficiency.

Nominal Watts.	50			60			100			120		
Efficiency Step.	High.	Med.	Low.	High.	Med.	Low.	High.	Med.	Low.	High.	Med.	Low.
Variable Cost of Energy.	Thousands of Lumen-Hours obtained per dollar expended for Power and Lamp Renewals.											
1 cent per kw. hour	222.	232.	**238.**	232.	**244.**	**244.**	232.	238.	**244.**	244.	250.	**256.**
2 " " " "	**135.**	**135.**	133.	**141.**	**141.**	137.	**139.**	**139.**	137.	**145.**	143.	139.
3 " " " "	**97.**	96.	94.	100.	98.	94.	**100.**	97.	94.	**102.**	99.	95.
4 " " " "	**76.**	74.	71.	**77.**	76.	72.	**77.**	75.	72.	**79.**	76.	72.
5 " " " "	**63.**	61.	58.	**63.**	61.	58.	**63.**	61.	58.	**65.**	62.	59.
6 " " " "	**53.**	51.	49.	**54.**	52.	49.	**54.**	52.	49.	**54.**	52.	49.
8 " " " "	**41.**	39.	37.	**41.**	39.	37.	**41.**	39.	37.	**42.**	39.	37.
10 " " " "	**33.**	31.	30.	**33.**	32.	30.	**33.**	32.	30.	**34.**	32.	30.
12 " " " "	**28.**	26.	25.	**28.**	26.	25.	**28.**	26.	25.	**28.**	27.	25.

shows the economy of the "Mazda" lamp over the carbon filament lamp as a producer of light.

These tables are based on the list price of the lamps. Where lamps are purchased in quantities large enough to secure quantity discounts the number of lumen-hours per dollar will be increased. The increase would be greater for low energy rate so that the effect of the lower cost of the lamp is to lower the energy cost at which the most economical conditions of operation (indicated by the figures in black-faced type) changes from low to medium or medium to high efficiency. In table No. 1 it will be noticed that the critical cost of power at which the point of maximum light output per dollar shifts from low to high efficiency, is lower the higher the wattage consumption of the lamp.

In cases where the percentage saving in the use of low efficiency is small the better color value of the light from the lamp operated at high efficiency together with the greater amount of light obtained from a single unit, are of much greater importance than the saving. For this reason it may be said that for the larger sizes of "Mazda" lamps high efficiency should be used for all costs of energy, exceeding 3 or 4 cents per kilowatt-hour. Similarly, carbon filament lamps should be burned at high efficiency for all costs of energy exceeding 2 cents per kilowatt-hour.

Comparing the table for "Mazda" lamps with that for carbon filament lamps it will be seen that the percentage saving of "Mazda" over carbon filament lamps is greater the higher the energy rate.

The effect of the introduction of the triple rating of incandescent lamps has been a greater flexibility to meet the large variety of conditions under which incandescent lamps are bought and used.

INTERNATIONAL ELECTRICAL CONGRESS AT PANAMA-PACIFIC EXPOSITION 1915.

One of the most fruitful results of a great international exposition is that brought about by the gathering together of the peoples of the world for discussion. At such times ideas are brought forth and comparisons of methods made which could never be accomplished in any other way.

That the great western metropolis of San Francisco is to be honored by the most distinguished electrical congress ever convened was assured by a recent action of the Board of Directors of the American Institute of Electrical Engineers. It will not be surprising if this congress assembled under the clear blue skies of California should awaken new scientific truths and instill new impetus for invention in the electrical industry.

Briefly the beginning of this great movement has had its inception in the following lines. We are indebted to the Electrical Review for the first inkling of the good news. At the meeting of the Board of Directors of the American Institute of Electrical Engineers, held on August 22, the following resolutions were adopted:

Resolved: That it is the sense of the Board of Directors that it would be desirable to hold an International Electrical Congress during the Panama Exposition in San Francisco in 1915, and that such a Congress be initiated and conducted by the American Institute of Electrical Engineers under the authority of the International Electrotechnical Commission.

Resolved: That in furtherance of the project to hold an International Electrical Congress during the Panama Exposition at San Francisco in 1915, a committee on Congress organization be authorized, the members of same to be appointed by the President after receipt of such information from the International Electrotechnical Commission as would indicate a disposition on their part to authorize the American Institute of Electrical Engineers in the holding of such a Congress.

FRAUDULENT OIL ENTRIES.

Three ways to get oil lands by false pretenses now used in California, so State Mineralogist Aubury says, are homestead entries, desert land entries and scrip filings. All of these methods have been tried in the San Joaquin Valley, so Aubury asserts, and the attempts to get valuable oil lands without any due observance of the law have been so successful that he has found it to be his duty to call the attention of the Federal officials to the matter.

MINE SAFETY DEMONSTRATION.

Thirty thousand miners are expected to attend the great national Mine Safety Demonstration to be held in Pittsburg, Pa., October 26 and 27 under the auspices of the Federal Bureau of Mines, the American Red Cross, the Pittsburg Coal Operators' Association and the United Mine Workers of America.

The demonstration, the purpose of which is to teach greater safety in mining, will begin the morning of October 26, at the experiment station of the Bureau of Mines, Fortieth and Butler streets. The first day will be devoted to the interests of the mine operators, mine owners, mining engineers and superintendents of mines. There will be an explosion of coal dust in the experiment gallery and tests of mine safety lamps in gas. The dangers of electric sparks in gas and coal dust will also be shown in the galleries.

SHORT-CUT IN ESTIMATING EXCAVATION OF YARDAGE IN DITCH CONSTRUCTION.

In ditch or railway surveys the location is usually made in 50 ft. or 100 ft. stations. The yardage in each 50 or 100 ft. segment is then figured by adding together the end areas in square ft., dividing by two and again dividing by 27 in order to convert into cubic yards. In order to save these successive steps the following tables have been carefully computed and double-checked.

In order to apply the table let us take a specific example. Let us suppose the sum of the end areas is 28.4 sq. ft. Find 28 in the first column, then read toward the right and under column headed .4 read 52.6. This means that a prism 100 ft. long whose end areas sum 28.4 sq. ft. contains 52.6 cu. yd. Should 50 ft. stations be used in location work, divide by 2 the amount so found. Where many stations are to be figured, the table will be found quick, accurate and a great time saver.

CUBIC YARDS IN PRISMS 100 FT. LONG BY SUM OF END AREAS.

	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	0	0.2	0.4	0.6	0.7	0.9	1.1	1.3	1.5	1.7	0
1	1.9	2.0	2.2	2.4	2.6	2.8	3.0	3.1	3.3	3.5	1
2	3.7	3.9	4.1	4.3	4.4	4.6	4.8	5.0	5.2	5.4	2
3	5.6	5.7	5.9	6.1	6.3	6.5	6.7	6.9	7.0	7.2	3
4	7.4	7.6	7.8	8.0	8.1	8.3	8.5	8.7	8.9	9.1	4
5	9.3	9.4	9.6	9.8	10.0	10.2	10.4	10.6	10.7	10.9	5
6	11.1	11.3	11.5	11.7	11.9	12.0	12.2	12.4	12.6	12.8	6
7	13.0	13.1	13.3	13.5	13.7	13.9	14.1	14.3	14.4	14.6	7
8	14.8	15.0	15.2	15.4	15.6	15.7	15.9	16.1	16.3	16.5	8
9	16.7	16.9	17.0	17.2	17.4	17.6	17.8	18.0	18.1	18.3	9
10	18.5	18.7	18.9	19.1	19.3	19.4	19.6	19.8	20.0	20.2	10
11	20.4	20.6	20.7	20.9	21.1	21.3	21.5	21.7	21.9	22.0	11
12	22.2	22.4	22.6	22.8	23.0	23.1	23.3	23.5	23.7	23.9	12
13	24.1	24.3	24.4	24.6	24.8	25.0	25.2	25.4	25.6	25.7	13
14	25.9	26.1	26.3	26.5	26.7	26.9	27.0	27.2	27.4	27.6	14
15	27.8	28.0	28.1	28.3	28.5	28.7	28.9	29.1	29.3	29.4	15
16	29.6	29.8	30.0	30.2	30.4	30.6	30.7	30.9	31.1	31.3	16
17	31.5	31.7	31.9	32.0	32.2	32.4	32.6	32.8	33.0	33.1	17
18	33.3	33.5	33.7	33.9	34.1	34.3	34.4	34.6	34.8	35.0	18
19	35.2	35.4	35.6	35.7	35.9	36.1	36.3	36.5	36.7	36.9	19
20	37.0	37.2	37.4	37.6	37.8	38.0	38.1	38.3	38.5	38.7	20
21	38.9	39.1	39.3	39.4	39.5	39.8	40.0	40.2	40.4	40.6	21
22	40.7	40.9	41.1	41.3	41.5	41.7	41.9	42.0	42.2	42.4	22
23	42.6	42.8	43.0	43.1	43.3	43.5	43.7	43.9	44.1	44.3	23
24	44.4	44.6	44.8	45.0	45.2	45.4	45.6	45.7	45.9	46.1	24
25	46.3	46.5	46.7	46.9	47.0	47.2	47.4	47.6	47.8	48.0	25
26	48.1	48.3	48.5	48.7	48.9	49.1	49.3	49.4	49.6	49.8	26
27	50.0	50.2	50.4	50.6	50.7	50.9	51.1	51.3	51.5	51.7	27
28	51.9	52.0	52.2	52.4	52.6	52.8	53.0	53.1	53.3	53.5	28
29	53.7	53.9	54.1	54.3	54.4	54.6	54.8	55.0	55.2	55.4	29
30	55.6	55.7	55.9	56.1	56.3	56.5	56.7	56.9	57.0	57.2	30
31	57.4	57.6	57.8	58.0	58.1	58.3	58.5	58.7	58.9	59.1	31
32	59.3	59.4	59.6	59.8	60.0	60.2	60.4	60.6	60.7	60.9	32
33	61.1	61.3	61.5	61.7	61.9	62.0	62.2	62.4	62.6	62.8	33
34	63.0	63.1	63.3	63.5	63.7	63.9	64.1	64.3	64.4	64.6	34
35	64.8	65.0	65.2	65.4	65.6	65.7	65.9	66.1	66.3	66.5	35
36	66.7	66.9	67.0	67.2	67.4	67.6	67.8	68.0	68.1	68.3	36
37	68.5	68.7	68.9	69.1	69.3	69.4	69.6	69.8	7.00	70.2	37
38	70.4	70.6	70.7	70.9	71.1	71.3	71.5	71.7	71.9	72.0	38
39	72.2	72.4	72.6	72.8	73.0	73.1	73.3	73.5	73.7	73.9	39
40	74.1	74.3	74.4	74.6	74.8	75.0	75.2	75.4	75.6	75.7	40
41	75.9	76.1	76.3	76.5	76.7	76.9	77.0	77.2	77.4	77.6	41
42	77.8	78.0	78.1	78.3	78.5	78.7	78.9	79.1	79.3	79.4	42
43	79.6	79.8	80.0	80.2	80.4	80.6	80.7	80.9	81.1	81.3	43
44	81.5	81.7	81.9	82.0	82.2	82.4	82.6	82.8	83.0	83.1	44
45	83.3	83.5	83.7	83.9	84.1	84.3	84.4	84.6	84.8	85.0	45
46	85.2	85.4	85.6	85.7	85.9	86.1	86.3	86.5	86.7	86.9	46
47	87.0	87.2	87.4	87.6	87.8	88.0	88.1	88.3	88.5	88.7	47
48	88.9	89.1	89.3	89.4	89.6	89.8	90.0	90.2	90.4	90.6	48
49	90.7	90.9	91.1	91.3	91.5	91.7	91.9	92.0	92.2	92.4	49
50	92.6	92.8	93.0	93.1	93.3	93.5	93.7	93.9	94.1	94.3	50

50	92.6	92.8	93.0	93.1	93.3	93.5	93.7	93.9	94.1	94.3	50
51	94.4	94.6	94.8	95.0	95.2	95.4	95.6	95.7	95.9	96.1	51
52	96.3	96.5	96.7	96.9	97.0	97.2	97.4	97.6	97.8	98.0	52
53	98.1	98.3	98.5	98.7	98.9	99.1	99.3	99.4	99.6	99.8	53
54	100.0	100.2	100.4	100.6	100.7	100.9	101.1	101.3	101.5	101.7	54
55	101.9	102.1	102.2	102.4	102.6	102.8	103.0	103.1	103.3	103.5	55
56	103.7	103.9	104.1	104.3	104.4	104.6	104.8	105.0	105.2	105.4	56
57	105.6	105.8	105.9	106.1	106.3	106.5	106.7	106.9	107.0	107.2	57
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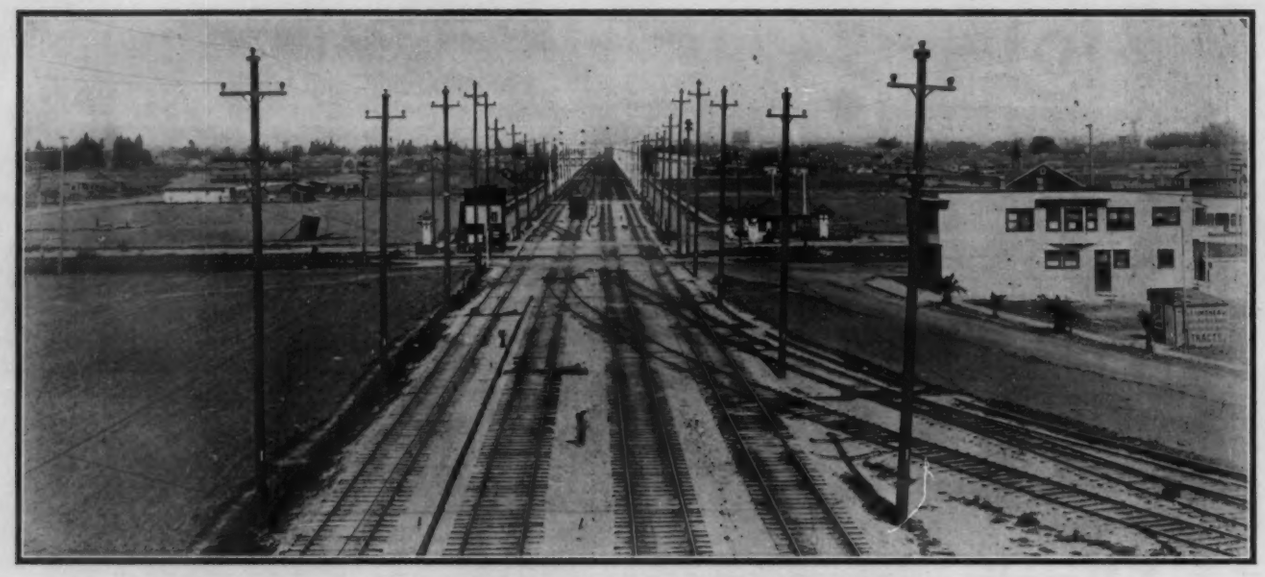
60	111.1	111.3	111.5	111.7	111.9	112.0	112.2	112.4	112.6	112.8	60
61	113.0	113.1	113.3	113.5	113.7	113.9	114.1	114.3	114.4	114.6	61
62	114.8	115.0	115.2	115.4	115.6	115.7	115.9	116.1	116.3	116.5	62
63	116.7	116.9	117.0	117.2	117.4	117.6	117.8	118.0	118.1	118.3	63
64	118.5	118.7	118.9	119.1	119.3	119.4	119.6	119.8	120.0	120.2	64
65	120.4	120.6	120.7	120.9	121.1	121.3	121.5	121.7	121.9	122.0	65
66	122.2	122.4	122.6	122.8	123.0	123.1	123.3	123.5	123.7	123.9	66
67	124.1	124.3	124.4	124.6	124.8	125.0	125.2	125.4	125.6	125.7	67
68	125.9	126.1	126.3	126.5	126.7	126.9	127.0	127.2	127.4	127.6	68
69	127.8	128.0	128.1	128.3	128.5	128.7	128.9	129.1	129.3	129.4	69
70	129.6	129.8	130.0	130.2	130.4	130.6	130.7	130.9	131.1	131.3	70
71	131.5	131.7	131.9	132.0	132.2	132.4	132.6	132.8	133.0	133.1	71
72	133.3	133.5	133.7	133.9	134.1	134.3	134.4	134.6	134.8	135.0	72
73	135.2	135.4	135.6	135.7	135.9	136.1	136.3	136.5	136.7	136.9	73
74	137.0	137.2	137.4	137.6	137.8	138.0	138.1	138.3	138.5	138.7	74
75	138.9	139.1	139.3	139.4	139.6	139.8	140.0	140.2	140.4	140.6	75
76	140.7	140.9	141.1	141.3	141.5	141.7	141.9	142.0	142.2	142.4	76
77	142.6	142.8	143.0	143.1	143.3	143.5	143.7	143.9	144.1	144.3	77
78	144.4	144.6	144.8	145.0	145.2	145.4	145.6	145.7	145.9	146.1	78
79	146.3	146.5	146.7	146.9	147.0	147.2	147.4	147.6	147.8	148.0	79
80	148.1	148.3	148.5	148.7	148.9	149.1	149.3	149.4	149.6	149.8	80
81	150.0	150.2	150.4	150.6	150.7	150.9	151.1	151.3	151.5	151.7	81
82	151.9	152.0	152.2	152.4	152.6	152.8	153.0	153.1	153.3	153.5	82
83	153.7	153.9	154.1	154.3	154.4	154.6	154.8	155.0	155.2	155.4	83
84	155.6	155.7	155.9	156.1	156.3	156.5	156.7	156.9	157.0	157.2	84
85	157.4	157.6	157.8	158.0	158.1	158.3	158.5	158.7	158.9	159.1	85
86	159.3	159.4	159.6	159.8	160.0	160.2	160.4	160.6	160.7	160.9	86
87	161.1	161.3	161.5	161.7	161.9	162.0	162.2	162.4	162.6	162.8	87
88	163.0	163.1	163.3	163.5	163.7	163.9	164.1	164.3	164.4	164.6	88
89	164.8	165.0	165.2	165.4	165.6	165.7	165.9	166.1	166.3	166.5	89
90	166.7	166.9	167.0	167.2	167.4	167.6	167.8	168.0	168.1	168.3	90
91	168.5	168.7	168.9	169.1	169.3	169.4	169.6	169.8	170.0	170.2	91
92	170.4	170.6	170.7	170.9	171.1	171.3	171.5	171.7	171.9	172.0	92
93	172.2	172.4	172.6	172.8	173.0	173.1	173.3	173.5	173.7	173.9	93
94	174.1	174.3	174.4	174.6	174.8	175.0	175.2	175.4	175.6	175.7	94
95	175.9	176.1	176.3	176.5	176.7	176.9	177.0	177.2	177.4	177.6	95
96	177.8	178.0	178.1	178.3	178.5	178.7	178.9	179.1	179.3	179.4	96
97	179.6	179.8	180.0	180.2	180.4	180.6	180.7	180.9	181.1	181.3	97
98	181.5	181.7	181.9	182.0	182.2	182.4	182.6	182.8	183.0	183.1	98
99	183.3	183.5	183.7	183.9	184.1	184.3	184.4	184.6	184.8	185.0	99
100	185.2	185.4	185.6	185.7	185.9	186.1	186.3	186.5	186.7	186.9	100

100	185.2	600	1,111.1	2,000	3,703.7	7,000	12,963.0	30,000	55,555.6	80,000	184,184.1
200	370.4	700	1,296.3	3,000	5,555.6	8,000	14,814.8	40,000	74,074.1	90,000	166,666.7
300	555.6	800	1,481.5	4,000	7,407.4	9,000	16,666.7	50,000	92,592.6	100,000	185,185.2
400	740.7	900	1,666.7	5,000	9,259.3	10,000	18,518.5	60,000	111,111.1	200,000	370,370.4
500	925.9	1,000	1,851.9	6,000	11,111.1	20,000	37,037.0	70,000	129,629.6	300,000	555,555.6



Electric Railway System Leading to Long Beach

GREAT ELECTRICAL ACTIVITY IN SOUTHERN CALIFORNIA.

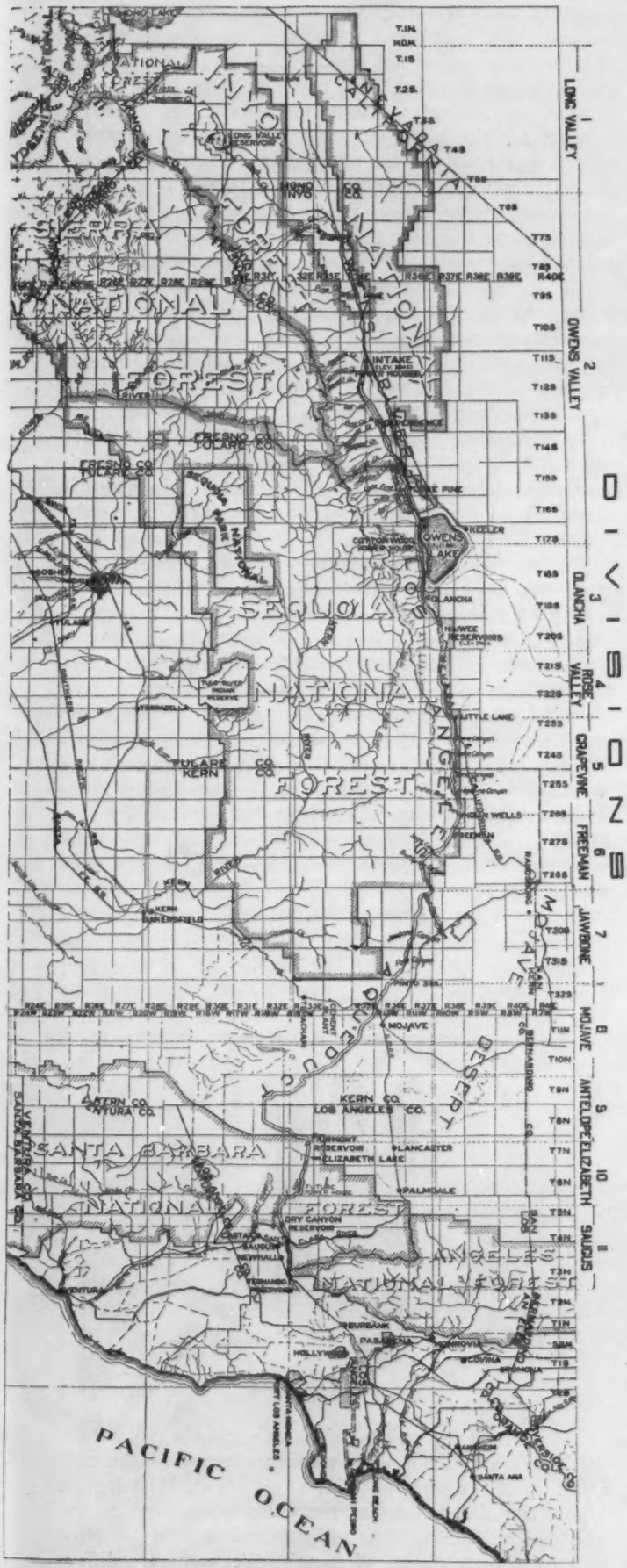
The steam plant of the Southern California Edison Company located at Long Beach, California, has recently been put into operation. The unit just completed has a capacity of 16,000 h.p. The generating unit is of the vertical steam turbine type and receives its steam from eight Sterling boilers. Crude oil is the fuel used.

John D. Miller, president of the company, recently spoke of the enormous demands for power in Southern California. Portions of his remarks have previously been printed in the Journal, but in view of the agitation in Los Angeles looking toward an early development of thousands of h.p. from the Owens River project by the city of Los Angeles, it is interesting to see how private corporations view this activity in the way of additional power output. Mr. Miller's remarks are as follows:

"During May of this year, the consumption of electricity for power purposes far exceeded the demand for light. Since 1904 our power business has been gradually gaining upon the light business, notwithstanding the enormous increase of the latter which grew 128 per cent during the period of 1904 to 1910. Power won out in the long run during the month of May showing an earning of $4,771.95 in excess of lighting.

Throughout the months of this year, 1911, the same condition has held—power showing an excess of $28,148.53. During the corresponding months of 1910 the condition was reversed, light exceeding power in May by $2,492.40 and in June by $16,837.55. In 1904 our power earnings were over 22% of our gross electric earnings; in 1905 they increased to 24%; in 1906 to 29%; in 1907 to 32%; in 1908 to 35%; n 1909 to 41% and in 1910 to 47% passing the 50% mark in May of this year as I have stated."

Ocean Scene at Long Beach, Where the Big Steam Plant Has Just Been Completed.



Owens River Project, Which Will Develop Thousands of Horsepower for Los Angeles.

PRIMER OF APPLIED THERMODYNAMICS.[1]

Second Lecture.

Thermometers and Calorimetry.

Having now acquired a clear conception of the difference between "quantity of heat" and "temperature," we shall next proceed to consider the various methods in use in determining the numerical values of these physical conceptions.

We have seen how the selection or construction of the scale to be employed in measurement of temperatures is arbitrary, but having decided upon our definite fixed physical temperature points, such as the freezing of water and its boiling under standard conditions we now proceed with methods and devices employed in construction of thermometers. In 1836, Pouillet, after a series of investigations, found that the temperature of furnaces can be estimated with considerable accuracy by the color of the fire, and that with a little practice the error at any high temperatures will not exceed 90 deg. or 100 deg. F. In 1899, Howe, Maunsel & Taylor revised the results of Pouillet's observations. These are shown in Fig. 5, where may be found the color of the fire opposite the particular temperature.

In a bulletin published by the Bureau of Standards in 1905, it is stated that skilled observers may vary 100 deg. F. or more in their estimation by color of relatively low temperature and beyond 2200 deg. F. it is practically impossible to make estimations with any degree of certainty.

The air thermometer is one of the most delicate means of measuring temperatures, but due to its necessary accurate adjustments and auxiliary scientific data to be taken simultaneously, its use is largely restricted to the physical and chemical laboratories. There are six principal methods or devices employed in engineering practice in determining temperatures and they are as follows:

1. Alcoholic thermometer.
2. Mercurial thermometer or pyrometer.
3. Expansion pyrometer.
4. Melting points of metals.
5. Le Chatelier's thermo-electric pyrometer.
6. Calorimetry.

1. As alcohol has a very low freezing point, in fact so low that it cannot be reached by any natural temperature, its use is especially recommended in measurements, where low temperatures are to be taken. Since its boiling point is comparatively low, it is not at all useful, however, for high temperatures.

2. Mercury is an excellent substance to use in thermometers, as the variation in its expansion coefficient with rise of temperature is such that the deleterious effect of the expansion coefficient in the glass tube is very nearly offset by the compensating error introduced by assuming a constant expansion coefficient for the Mercury. Mercury boils at 676 deg. F. and for many degrees below this point gives off considerable vapor. As a consequence the ordinary mercurial thermometer can not be depended upon for a higher tem-

[1] A resume, devoid of higher mathematics, covering the essentials of a series of lectures now being given by the editor of this Journal before the Senior Mechanical Engineering students at the University of California.

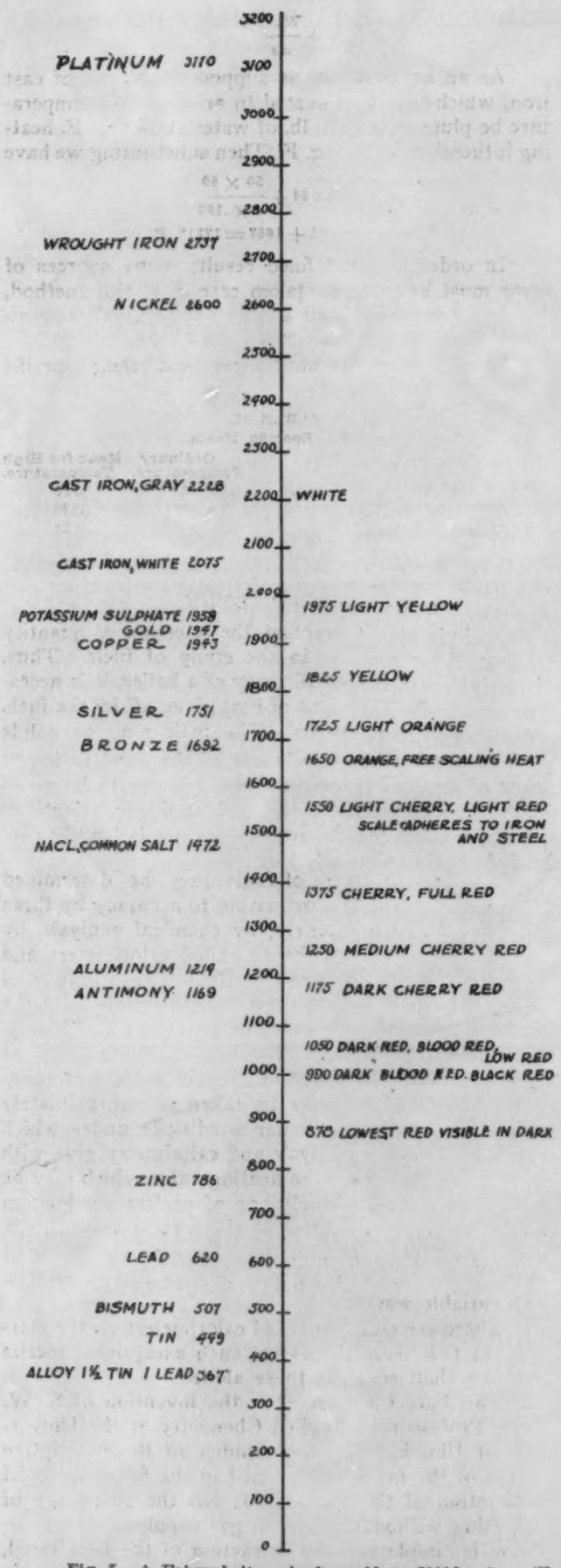


Fig. 5. A Fahrenheit scale from 0° to 3200°. On the left is a list of melting points of metals and on the right the colors of a furnace fire at particular temperatures.

perature than 500 deg. F. A very ingenious device, nevertheless, enables us to make use of the mercurial thermometer up to 800 deg. F. A small amount of nitrogen gas is put in the upper column of the tube and as the mercury column expands it consequently compresses the nitrogen gas. The reactive pressure of the gas upon the mercury raises its boiling point sufficiently to allow us to read up to 800 deg. F., as mentioned above. Since chimney gases are below this temperature, the mercurial pyrometer is very appropriate for determination of their temperatures. The bulb of the instument should project into the path of maximum velocity of the escaping gases in order that average temperature may be obtained, and before a reading is taken, it is necessary to keep the thermometer inserted in the flue socket from seven to fifteen minutes, depending on conditions.

Expansion pyrometers are useful for temperatures up to 1500 deg. F. It is a matter of common knowledge that when heat is applied to a substance it changes its volume, usually by increasing the volume, although there are notable exceptions. Different bodies expand by different amounts for the same increase in temperature. If now we take an iron pipe and within it insert a brass rod which expands about 50 per cent more than iron for a given rise in temperature, we can by rigidly attaching one end of the brass rod to a cap on one end of the iron pipe, construct a device that will indicate the temperatures. All that is necessary to do is to attach a multiplying device to the free ends and calibrate the readings of a pointer actuated by the multiplying device. When the instrument is first placed in a fire, it is found to read backwards, and when taken out it runs higher up the scale before dropping to the lower temperature. This is caused by the fact that the new change of temperature is first felt in the iron since time is necessary to conduct heat into the brass, consequently in the use of an instrument of this sort great care must be exerted to see that temperatures are even throughout the entire lengths of iron and brass.

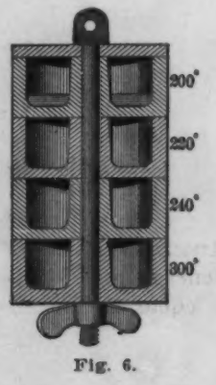


Fig. 6.

The melting points of metals give a very convenient method for determining ranges of temperature up to the melting point of platinum, 3110 deg. F. Upon the diagrammatic representation, Fig. 5, are platted various melting points, and it will be seen that by proper choice of metals. Temperature differences of every 200 deg. change can be noted. A device similar to Fig. 6 is convenient in the arrange-

ment of the metals for this test. As will be noted the method lacks accuracy, but it suffices very well for the approximate determination of the temperatures of the furnace, and in different parts of the tubes of a boiler.

Of the many useful and practical engineering methods at our disposal for the measurement of high temperatures, the most accurate, and at the same time the most interesting, is that known as the thermo-electric pyrometer. It is a peculiar phenomenon, yet none the less true that if we join together two different metals and heat this junction, an electromotive force is set up between the outer ends of the wires. This electromotive force depends upon two things, first the composition of the wires and second the temperature. Hence if we choose any two wires, the electromotive force depends directly upon the temperature. In the thermo-electric pyrometer of Le Chatelier, the wires are platinum and a 10 per cent alloy of platinum and rhodium, inclosed in porcelain tubes to protect them from the oxidizing influence of the furnace gases. Since, as noted above, the electromotive force, depends on the temperature of the junction alone it is not necessary to expose the entire element to the fire, bue solely the junction, nor is it necessary that the galvanometer or instrument used to measure the electro-motive force be near the element—as a considerable addition of lead wires has no practical effect on its readings. The continuity of the readings by means of a thermo-electric device is perfect, and, as it is extremely accurate, the ease with which the readings are made commends its use. The high first cost of the instrument is its material drawback for universal adoption.

Of all the methods of temperature measurement, that known as the calorimetry process is the most readily accessible, and where extreme accuracy is not desired, it is found to be most useful. The savage long since discovered that water in a scooped out log could be made to boil, not by putting the inflammable log over his fire but by dropping into the water-filled hollow log heated rocks picked from the hot coals. So it is, if we take from a boiler furnace a piece of iron heated to the same furnace temperature and drop it into water, the temperature of the water is raised a definite amount, and if we know the weight of the hot substance, its specific heat together with the weight of the water and its rise in temperature, we can compute the temperature of the furnace whence came the hot body. Since we have found that heat is a form of energy, and since energy is indestructible, if there is no radiation, the amount of heat energy given up by the hot substance must be exactly equal to the amount gained by the water.

Hence if—

X = unknown temperature of the hot substance.
w = weight of hot substance in lb.
W = weight of water in lb.
T = final temperature of water.
t = temperature rise, or difference between initial and final temperatures of water.
s = specific heat of hot substance, then, since heat lost by hot substance = heat gained by water

$$w\,(X-T)\,s = Wt$$
$$wsX - wsT = Wt$$
$$\text{or } X = T + \frac{Wt}{ws}$$

As an example, let us suppose that 4 lb. of cast iron, which has been heated to an unknown temperature be plunged into 20 lb. of water at 64 deg. F. heating it thereby to 124 deg. F. Then substituting we have

$$X = 64 + \frac{20 \times 60}{4 \times .180}$$
$$= 64 + 1667 = 1731^\circ \text{ F.}$$

In order to get refined results many sources of error must be properly taken care of in this method, but for convenience and application to usual approximate temperature tests, it excels all others.

Some convenient substances and their specific heats are as follows:

TABLE II.
Mean Specific Heats.

Substance.	Ordinary Temperature.	Mean for High Temperature.
Platinum	.032	.038
Iron (cast)	.130	.180
Nickel	.109	.136
Fire	.200	.260

CALORIMETRY

In engineering practice, the question of quantity of heat usually arises in the study of fuels. Thus, in order to obtain the efficiency of a boiler, it is necessary to know the amount of heat given off by the fuels employed in combustion. The fuels may be solids such as coal, wood, bagasse, or liquids such as petroleum, or gases such as natural or producer gas. The different methods in practice employed in the measurement of quantities of heat are classified under the heading of calorimetry.

The heating value of fuels may be determined with more or less approximation to accuracy by three different methods; namely, by chemical analysis, by combustion in one of the so called calorimeters and by actual trial in a steam boiler. The accuracy of the first two methods depends on the precision of the method of analysis or calorimetry adopted, and upon the care and skill of the operator. The results of the third method are subject to numerous sources of variation and error, and may be taken as approximately true only for the particular conditions under which the test is made. Analysis and calorimetry give with considerable accuracy the heating value which may be obtained under the conditions of perfect combustion and complete absorption of the heat produced. A boiler test gives the actual result under conditions of more or less imperfect combustion, and of numerous and variable wastes.

There are many forms of calorimeters on the market but two seem to possess such exceptional merits that we shall consider these alone.

The Parr Calorimeter is the invention of S. W. Parr, Professor of Applied Chemistry at the University of Illinois. A large number of the descriptive words of the inventor are used in the following brief description of the process. It has the advantage of operating without an oxygen gas supply; its manipulation is simple and the extraction of the heat rapid, owing to the compact mass in which the heat is

generated. It is designed for technical purposes and its factor of error is well within 0.5 per cent. The Parr Calorimeter depends for its action upon the liberation of oxygen from a compound which shall in turn absorb the products of combustion, conditions admirably met in sodium peroxide; this obviates the necessity of providing for an outlet for those gases and also any loss arising from the heat they might carry off.

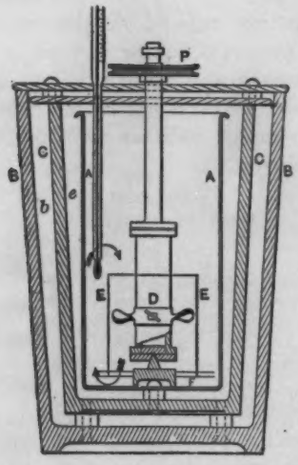


Fig. 7.

A, Fig. 7, is the calorimeter of about two liters capacity, insulated by two outer vessels of indurated fibre, B and C, so placed as to provide further insulation by the air-spaces b and c. The cover is double, to correspond with the air-space between, the two parts being connected for convenience in handling. The cartridge D has a capacity of about 25 cubic centimeters; it rests on a pivot below, extends through the covers, and has a small removable pulley at the end. Turbine wings fastened to spring clips placed on the cartridge, and a short cylinder E, open at both ends, is provided for directing the current set up by rotation of the vanes attached to the cartridge. The stem of the cartridge is so arranged as to permit the passage of a short piece of No. 12 copper wire to ignite the charge; it is provided with a valve D at the lower end to prevent the escape of the enclosed air.

A test is made in the following manner. One gram of coal ground to pass a 100-mesh sieve, dried at 105 deg. C., is put into the cartridge, 16-18 grams of sodium peroxide added, the top screwed on, and the whole shaken to thoroughly mix the contents. The peroxide should be fine enough to pass a 25-mesh sieve. The cartridge is tapped to settle the charge to the bottom, then placed in the calorimeter which contains two liters of water. It is then rotated 50 to 100 revolutions per minute. The water should be 3 to 4 degrees lower than the room temperature. When the temperature has become constant the thermometer is read, a hot wire dropped down, ignites the charge, which burns completely. The extraction of the heat is effected in about five minutes; the reading of the maximum temperature is taken and the calculations made as follows: the rise of temperature is corrected, first, for that produced by the hot wire; this amounts to 0.006 deg. C. per ¼ inch of No. 12 copper wire; second, for the heat produced by the combination of the sodium peroxide with the carbon dioxide and water formed by the combustion; this amounts to 27 per cent of the total indicated heat. If C equals the heat of combustion of the coal, C^1 the calories indicated, t the rise of temperature, and w the water employed, then

$$C^1 = (t - 0.006°) \times W, \quad C = C^1 - \frac{C^1 \times 27}{100}$$

$$\text{or} \quad C = (t - 0.006°) \times W \times 0.73.$$

The residue from the combination contains the carbon of the coal in the form of sodium carbonate. The volume of carbon dioxide may readily be measured, and from this the total carbon of the coal can be calculated. This is a result not heretofore available except by ultimate analysis, and enhances the value of the instrument.

The Sargent automatic gas calorimeter is used to determine the calorific value as well as the foreign matter in gases. The method is quick, simple and accurate. Fig. 8 shows a section of the Sargent calorimeter. It is seen that the inlet water having a constant head at the cistern E, the temperature of which is taken at C, envelopes the whole instrument and passes through in the direction of the arrows. The rise in the temperature is taken by the thermometer at D before any heat is lost by radiation to the air. The combustion of gas takes place in the central flue, and the products of combustion pass to the top and down the annular chambers in the direction of the arrows, reaching the temperature of the water before

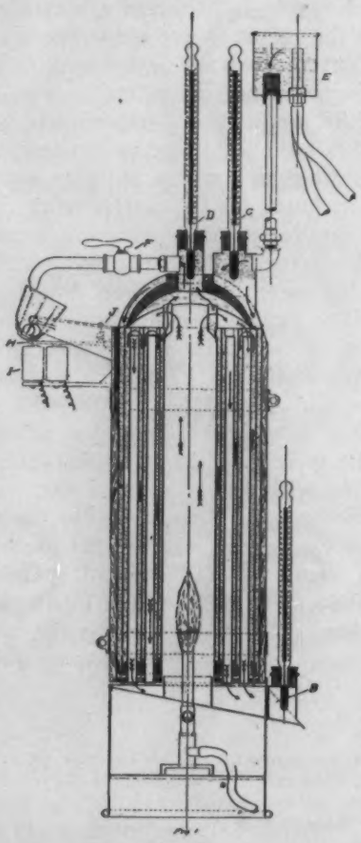


Fig. 8.

passing out at B, where a damper regulates the velocity, and the thermometeer gives the temperature of the exhaust products. A device is attached so that

the amount of water is very accurately weighed every time 1-10 of a cubic foot of gas is consumed. By means of the thermometers, the rise in temperature is ascertained, consequently we are enabled to compute at once the calorific value of the gas.

Thermotwisters.

1. Convince yourself of the enormous amount of latent energy stored in 10 lb. of coal. Assume that each lb. of coal has a calorific value of 14,500 B.t.u. Convert into mechanical energy and estimate the vertical aerial journey you could take on this energy, were it exploded under you and your body were able to absorb all the energy.

2. In a heat engine test, each pound of steam leaves the engine containing 125.2 B.t.u. less heat than when it entered the cylinder. The engine develops 155 h. p., and consumes 3160 lb. of steam per hour. Compute the mechanical equivalent of heat.

3. In a test to determine the calorific value of anthracite coal by means of a Parr Calorimeter, ½ gram of the coal was properly burned and a temperature rise of 2.040° C noted. How many B.t.u. of heat per lb. of coal?

4. A piece of wrought iron bar, weighing one-half lb., is thrown into the furnace and heated to the temperature of the fire, and is then withdrawn and placed in a pail containing 10 lb. of water. The original temperature of water was 60 deg. F., and after the immersion of the iron, the temperature rose 20 deg. Find temperature of the furnace.

ELECTRICAL ACTIVITY IN NORTHERN CALIFORNIA.

A deal that gives the Siskiyou Electric Power & Light Company absolute monopoly of the water power resources of northern California and southern Oregon was made recently when the Rogue River Electric Company sold its light and power plants to the Siskiyou company for $3,300,000. Those concerned deny the merger is the work of the Western Power Company, the so-called power trust, of which Colonel Frank Ray, owner of the Rogue River Electric, is vice-president. It is known, however, that the Western Power Company has acquired control of practically all the power plants in northern California, and that its eyes have been on Oregon. Owning power plants and controlling the power of Rogue River, Klamath River and the little Shasta River, besides that of smaller streams, the combination is the most gigantic ever made in this part of the State.

When the work now under way is completed this fall to a total of 80,000 horsepower at low water can be generated in this immense plant. Jesse W. Churchill, president, and J. P. Churchill, vice-president of the Siskiyou company, were the officials who met Colonel Ray. With the Churchills are Alex J. Rosborough and F. Detristan of Paris, representing a wealthy French syndicate.

SWISS AUTHORITIES ADOPT SINGLE PHASE SYSTEM FOR STATE RAILROAD ELECTRIFICATION.

In the Daily Consular and Trade Reports of August 28, 1911, the following statement in regard to the electrification of the Swiss State Railways appears:

"I am able to state on the highest possible authority that the report of the Swiss Commission which has been investigating the question of the electrification of the Swiss national railways will recommend the adoption of the overhead system similar to that which is now in use upon the London Bridge, Victoria & Crystal Palace Lines of the London, Brighton & South Coast Railway. This decision has been arrived at after a most careful comparison with the third-rail system as adopted upon the underground railways of London and other electric railways in this country.

The importance of electric railway working was fully recognized by the Swiss State authorities as far back as 1904, when a commission of 22 experts was appointed to study the matter. Up to the present time three reports have been issued by this commission; the first deals with the probable power requirements of the whole Federal system, consisting of 1830 miles; the second concerns the nature of the traffic, and the third deals with the most suitable system; that is, continuous current or alternating current. The report about to be issued will recommend the adoption of a single-phase, alternating current system with a pressure of 15,000 volts in the overhead wires. The first work to be taken in hand will be the conversion of the St. Gothard Railway, and comparative estimates have shown that the adoption of the third-rail continuous current system, so much in use in London, would involve a capital expenditure of about 8 per cent more than with the overhead system.

The total cost of conversion to electric traction upon the overhead system is estimated at $13,140,000, while the running costs are estimated at about 10 per cent less than the present cost with steam traction. Although no specific sums were mentioned in the Swiss budget for 1911 for the electrical equipment of railways, certain amounts were included for the acquisition of water power for the generation of the necessary electrical energy and also for further preliminary calculations and estimating work."

CENSUS RETURNS FOR POWER AND FUEL IN ARIZONA.

The increase in primary power from 1904 to 1909 was in power generated by steam engines, both water power and power generated by gas engines showing a decrease. However, a slight increase in the number of gas engines is shown, there being 31 such engines in 1909, as compared with 28 in 1904, although the total horsepower developed by them decreased from 1,392 in 1904 to 1,285 in 1909. The figures also show that the practice of renting power is on the increase, 9 per cent of the total power being rented in 1909, as compared with 1.9 per cent in 1904 and 0.4 per cent in 1899. The use of electric motors for the purpose of applying the power generated within the establishments is also shown to be increasing rapidly, the horsepower of such motors increasing from 496 in 1899 to 4,656 in 1904 and to 11,786 in 1909.

Closely related to the question of kind of power employed is that of fuel used in generating this power, or otherwise as material in the manufacturing processes. All industries in 1909 used 7,561 tons of anthracite coal; 60,256 tons of bituminous coal; 463,233 tons of coke; 14,558 cords of wood; 610,594 barrels of oil, including gasoline; 1,865,000 feet of gas; and 20 tons of other fuel.

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FOUNDED 1887 AS THE
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Traffic Expert for San Francisco

The congestion of traffic in the business centers of San Francisco has already become apparent, and it is most opportune that the Finance and Public Utilities Committee has decided to engage an expert with his corps of assistants to make a thorough investigation and recommendation for future improvements. At certain hours during the day the business of the great western metropolis has a tendency toward becoming paralyzed through lack of traffic facilities. If this is the case now, a situation of embarrassment is to be anticipated when the rush of exposition visitors and the enormous consequent increase in traffic arrives unless needed improvements and enlargements are undertaken at once. Bion J. Arnold, the well known municipal expert, has been engaged for this work. Mr. Arnold comes to this field loaded with experiences derived from similar investigations in a half dozen other great American cities, and the results of his efforts will be watched by all with great expectancy.

New Power Industries

It is interesting to note the new uses for electrical power in the west springing up about us almost daily. The housewife in thousands of western homes has long since found the electric iron, not only a convenience, but, when needed for short service, an actual economy. The recent experiments in orcharding in parts of the northwest, wherein electricity is made use of in combating the codlin moth, will be watched with considerable interest. Should it prove a success, thousands upon thousands of dollars annually spent in sprays and other chemicals will be diverted into revenue for the power plant. The sawmill was formerly thought to be the last stronghold of steam, but fortune is a cruel goddess, and we not only find electrically operated sawmills on the increase, but even the steam equipment in the logging camps is giving way to modern electrically driven machinery. The donkey engine, thought by all to be the one fortress to forever baffle economic electrical manipulation, is one of the latest conquests and will be found described elsewhere in these columns. The greatest field for future power uses, however, unquestionably lies dormant in the great undeveloped arid tracts of land awaiting water to make them yield the remarkable crops known only to Western soil. In the struggle and strife for water during the past years, engineers have schemed and planned gravity systems until, today, the number of combinations is about exhausted. Pumping plants must be the solution for the future. The State Engineer of Idaho estimates that there are in his State acreages by the millions that are susceptible of economic irrigation by this method. Similar conditions are to be found in other commonwealths of

the West. In Southern California where the combinations of gravity systems were long since exhausted, the new installations of electrically operated pumps have already swelled the power consumption of the Edison Company so that their power sales exceed their sales for lighting purposes. Thus hand in hand our western agricultural and power development will increase. Surely a great empire never offered a more flattering outlook for substantial growth.

Rating of Incandescent Lamps

There are in general two methods utilized in creating light by electrical energy—the electric arc and the incandescent lamp. In the incandescent lamp an electric current is passed through a solid conductor known as a filament, which is heated to incandescence by the electrical energy being dissipated as heat according to well-known physical laws. This filament is found to operate best where enclosed in a glass globe from which the air has practically been exhausted.

In order to make comparisons of one lamp with another, certain units of light output are necessary, as the ultimate aim of lamp manufacturing is to produce the most light for the least money. Lamps were first rated in watts consumed per mean horizontal candle power. This is not a strictly accurate or fair method, however, as horizontal candle power bears a variable proportion to the total light flow or flux for different makes of lamps. Hence the mean spherical candle power was adopted, which averages conditions, taking into account the entire amount of light emanating from the lamp. For instance, with the carbon filament lamp the reduction factor necessary to transform from mean horizontal to mean spherical candlepower is usually .79. Hence a sixteen candle power lamp has a mean spherical candle power of $16 \times .79 = 12.6$ c. p., and at an efficiency of 3.1 watts per horizontal candle power, has an efficiency of 3.92 watts per mean spherical candlepower.

It is interesting to note the progress in efficiency by scientific study and invention in the incandescent lamp industry. As an improvement over the carbon filament, first came the osmium lamp, which required but 1.5 watts per candle power. Since the entire world's supply of osmium would be exhausted in the lamp production of one year we cannot hope much from this quarter. Next came the tantalum lamp with an efficiency of about 2 watts per candle power, and finally the tungsten lamp with its efficiency of 1 to 1¼ watts per candle power. As tungsten metal has the highest melting point of all known metals, it can be operated at the highest temperature, consequently with the highest efficiency. In the busy struggle of competition the lamp companies have done much in educating the public to a fuller realization of economic methods of lamp use.

In our domestic life, after we have worn a suit of clothes for a time, some of us discard it at the change of the season, others upon its becoming glossy, others wait until the bottoms of the trousers become thread-bare, and still others have no definite point of abandonment, but wear it on and on to the discredit of our personal appearance and the amusement of our non-admiring friends. In a word the whole question of the proper time for putting on a new suit of clothes varies immensely with the individual, no definite cut-and-dried mathematical formula having ever been put forth. The particular time for a change is solved by the individual judgment of the user. Thus would have been uses in the lamp industry had it not been for the wide-awake lamp companies. The thousands of private homes would have continued to burn their lamps till the lamp became broken or the fancy of the user operated in a change.

Elsewhere in these columns will be found an article on the triple rating of lamps. It is shown that in general two factors enter into the cost of light, one the energy charge and the other the lamp charge. The former is an increasing direct proportion with watts per candle power, but the latter decreases with the same variable. Now then, by algebraically adding those two curves, point by point,, a third curve is deduced showing the absolute cost. This curve shows a definite point at which the cost not only ceases to decrease with watts per candle power but actually increases. This point is graphically determined by picking out the point in the third curve nearest the horizontal abscissa line. It is evident that upon the cost of power the steepness of the energy cost line will depend. Thus when power is cheap, this line will be comparatively flat. This in turn affects the total cost curve by making the minimum point further to the right, which evidently means that where power is cheap, low efficiency lamps are most economical and conversely where power is high, high efficiency lamps are by far the best to use. To meet these varying conditions of energy cost, a triple rating of lamps has been introduced by the lamp companies, so that purchasers may use lamps best adapted to this varying quantity.

As this educational campaign on the part of the lamp companies continues, more and more will the lamp users realize that not only definite voltages are best adapted for economic conditions, but, unlike the effect of the loosely drawn lines for discarding of clothes, the actual abandonment of lamps for new ones, at the arrival of the end of the definite useful period is a scientific economy and the more carefully attended to, the more money will it be in the pocket.

The electric lamp is today the means of lighting the millions of American homes. Its scientific study and economic use enters the inner vail of our home life. The educational campaign in behalf of its proper uses is due to the energy and enterprise of the American lamp companies and to them must be given all credit.

PERSONALS.

F. O. Sievers, of the Fort Wayne Electric Works sales force, is spending a vacation in the mountains.

S. N. Griffith, an electric railway promoter of Fresno, arrived at San Francisco during the past week.

C. R. Downs, the head of the waterworks system at Sutter Creek, was a recent San Francisco visitor.

Wm. Stranahan, manager of the Coalinga Water & Electric Co., was at San Francisco last week from Coalinga, Cal.

K. G. Dunn, engineer with Hunt Mirk & Co., returned to San Francisco during the past week, after a business tour of the Pacific Northwest.

W. J. Beck, an official of the New York Edison Company, who is touring the Pacific Coast, arrived at San Francisco during the past week.

William D. Ward, of the Pelton Water Wheel Company's sales force, has been visiting the Rocky Mountain region of the Northwest on hydroelectric business.

A. H. Halloran, managing editor of the Journal of Electricity, Power and Gas, is enjoying a few days' outing in Los Angeles, combining business with pleasure.

H. A. Lardner, manager of J. G. White & Co.'s Pacific Coast Branch, recently returned to his San Francisco headquarters after an inspection tour of Southern California.

Tracey E. Bibbins, of the General Electric Company's engineering staff, recently returned to San Francisco, after attending the National Electrical Jobbers' Convention in the East.

E. E. Trowbridge, an attorney of Los Angeles, whose advice has had much to do with the development of the Southern California Edison Company, recently spent a few days at San Francisco.

E. B. Strong, president and manager of the Technical Publishing Co., publishers of the Journal of Electricity, Power and Gas, after an eastern business trip covering several months, is again back at the San Francisco office.

W. S. Woodridge, manager of the Pacific Coast office of Ford, Bacon & Davis, of New York, returned last Monday after inspecting the work in progress, on the Sierra & San Francisco Power Company's new dam on the Stanislaus River.

F. G. Baum, of F. G. Baum & Co., has secured a franchise for the erection and maintenance of poles, towers and electric transmission lines through Monterey County. The electric power line, which his company is constructing south from Salinas, has been completed for a distance of nine miles and will be extended to 70 miles.

A party of the Pacific Gas & Electric Company's engineering staff, including J. H. Wise, assistant general manager; J. P. Jollyman, the new engineer of electrical construction; and P. M. Downing, engineer of operation and maintenance of hydroelectric plants, have returned from an inspection tour of the hydroelectric developments in the Sacramento Valley district.

Ralph D. Mershon, of New York, is at San Francisco in charge of an exhaustive engineering investigation of the electric generating plants and electrical equipment of the local and suburban traction systems of the Oakland Railways Company, a subsidiary corporation of the United Properties interests. A great increase in the capacity of these plants will be necessary to provide for the projected extensions of the Key Route and Oakland Traction lines. It is understood that Mershon's report will be a basis for the future financing on a large scale for many contemplated improvements.

TRADE NOTES.

The Great Shoshone & Twin Falls Water Power Company, of Twin Falls, Idaho, has placed an order with the Westinghouse Electric & Mfg. Company for five 75 kva., 24000 volt, oil-insulated, self-cooled transformers.

The General Electric Company has sold to the Southern California Edison Company, one 2000 k.v.a., 500 r.p.m., 11,000 v., 3-phase, 50 cycle, 2 bearing, synchronous condenser, to be direct connected to exciter.

The Pacific Gas & Electric Company, of San Francisco, Cal., has recently placed with the Westinghouse Electric & Mfg. Company an order for ten 1000 kva., oil-insulated, self-cooled, tubular type, 11000 volt transformers.

Exhaust turbine generators have become a feature of the best sawmills in the State of California. The Yosemite Lumber Company which is building a large sawmill plant at Merced Falls, recently ordered from the Allis Chalmers Company a 450 kw. normal, mixed-pressure turbine generator set. A turbine condenser and auxiliary apparatus with switchboard complete, were also included in the contract.

The Brilliant Electric Company, 401 Electric Building, Cleveland, Ohio, has opened at 151 New Montgomery street, San Francisco, a branch office which will be in charge of Mr. E. D. Hand, the company's Pacific Coast representative. Orders for incandescent lamps received at the new office will be covered by prompt shipments from the neighboring warehouse at Oakland. Another "Brilliant" office has been opened in Los Angeles, California.

K. G. Dunn, with Hunt, Mirk & Co., is visiting San Diego, where his firm has been installing a 1000 kw. exhaust turbine generating set with Westinghouse reducing gear, which is the first of that type on the Pacific Coast. The Allis-Chalmers Corliss main engine was started up last week and the new turbine has since been turning over with everything working satisfactorily. Manager of Motive Power McNutt of the San Diego Electric Railway Company, has the supervision of the new plant.

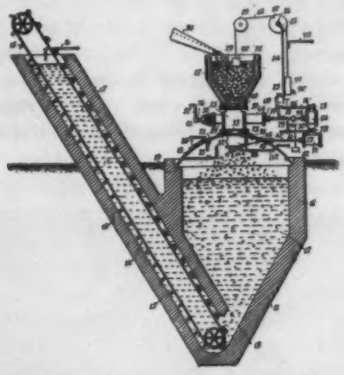
John S. Baker, who, for several years past, was at the head of the electric motor sales department of the General Electric Company, in this city, has been appointed District Manager of the Crocker-Wheeler Company's new Pacific Coast branch with headquarters at Room 400, First National Bank Building, San Francisco. Mr. Baker is well equipped for his position and will be prepared to reach out for business with a full line of alternating motors in addition to the a.c. generators formerly turned out by the Crocker-Wheeler factory.

NEW CATALOGUES.

The new 100-page catalogue of the Fostoria Glass Specialty Company entitled "Illuminating Glassware" lists, and illustrates by means of half-tone cuts, more than 1500 different styles of clear cut and etched globes, shades and reflectors for electric and gas lamps. In respect to the number of styles illustrated, this is probably the most comprehensive catalogue ever distributed by an American glass company; it is in fact a veritable reference work on the numerous schools of design and profusion of shapes exemplified in modern decorated illuminating glassware. The book itself is most attractively put together, and in spite of its scope is not at all unwieldly. It will be mailed gratis to persons interested in its contents from a commercial or professional standpoint. Applications should be made to the company's headquarters at Fostoria, Ohio, and should specify "Catalogue No. 52." "Iris," or iridescent glassware, is described in a separate publication by the same company.

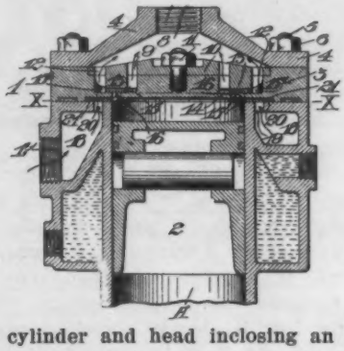
PATENTS

1,001,290. Steam-Generator. William E. McKee, Bisbee, Ariz. A steam generator comprising a container for water



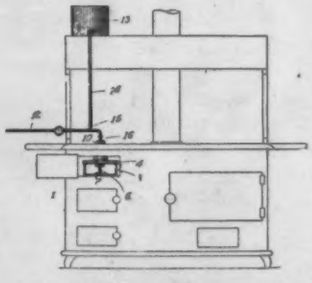
provided with a slag inlet, a valve controlling the slag inlet and means responsive to the flow of slag for controlling the operation of said valve.

1,001,305. Air-Compressor. Edward A. Rix, Oakland, Cal. In an air compressor, the combination of a cylinder having



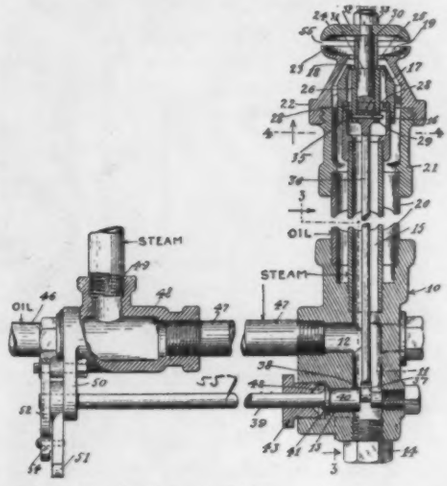
a head, said cylinder and head inclosing an annular valve chamber of larger diameter than the cylinder bore, said chamber having its inside periphery open directly to the cylinder bore, said cylinder having ports into said chamber, and a thin annular detached plate valve of greater diameter than the cylinder bore in the cavity operative puppet-fashion solely by the forces of gravity suction and compression to control said ports.

1,001,143. Oil-Burner. Fred Hendricks, Lodi, Cal. A device of the character described comprising the combination with a stove having a central orifice above the fire box,



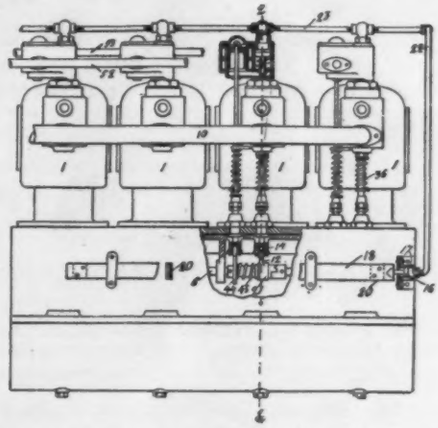
of a burner pan comprising a bottom member having an upwardly projecting flange all around its contour, further projecting side members centrally located on each side of said pan, a centrally orificed removable lid on said side members, a central pin projecting upwardly from the said pan, a cup-like receptacle on the lower end of said pin, an inverted cup-like receptacle on the upper end of said pin, said inverted receptacle having a plurality of orifices, a hood disposed over the orifice in said lid and projecting through the orifice in said stove, said hood having a plurality of recesses in its lower edge, an oil feed pipe discharging through said hood and said orifices in said stove and lid and on to said inverted cup-like receptacle, and a water supply pipe communicating with said oil pipe as described.

1,001,557. Hydrocarbon-Burner. Hiram C. Ruggles, Pasadena, Cal. A hydrocarbon burner, comprising a base member having a steam-way opening therethrough, a nozzle formed on the upper end thereof, a support mounted in said nozzle and extending therethrough, an inverted cup-shaped plate mounted on said support, an oil-way formed in said base member and terminating in the upper end thereof adjacent the



steam nozzle in a discharge orifice, said oil-way surrounding said steam-way, a cup-shaped chamber formed on the upper end of said oil-way adjacent said discharge orifice, said cup-shaped chamber forming with the inverted cup-shaped plate a mixing chamber, and means to regulate the size of the opening in the steam nozzle.

1,001,595. Internal-Combustion Engine. Szymon Jachimovicz, Berkeley, Cal., assignor of one-half to M. Grodin, Oakland, Cal. In an internal combustion engine having inlet and outlet valves and shafts rotating in fixed bearings, loose



cams on said shafts for controlling said valves in both directions of motion of said shafts, means for shifting the cams longitudinally upon the shafts, and means for shifting the cams circumferentially upon the shafts.

INDUSTRIAL

RECENT IMPROVEMENTS IN DISTRIBUTING TRANSFORMERS.

About three years ago such marked improvements were made in the design of single-phase distributing transformers that it was thought for a time that further improvements were practically impossible. These improvements were first embodied in the type S transformer developed by the Westinghouse Electric & Mfg. Company, East Pittsburg, Pa. They consisted principally in a radically new shell design of magnetic circuit whereby low magnetic reluctance is obtained without increasing the mean length of turn of the winding,

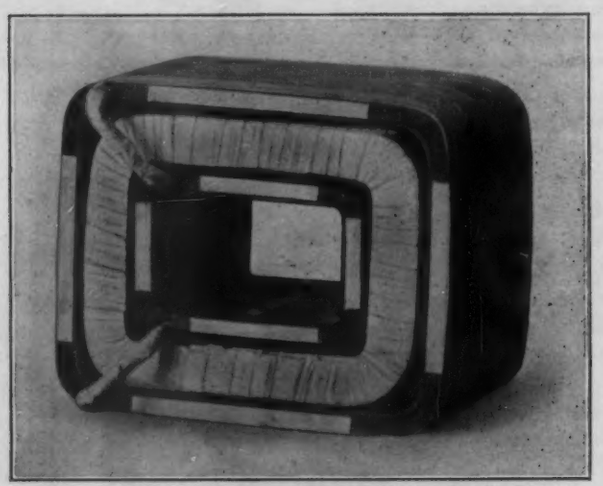


Fig. 1. Improved Transformer High Tension Coils Showing the Many Sub-divisions Used.

and which was especially adapted for the use of the new silicon steel for the magnetic circuit. These improvements resulted in a marked increase in efficiency, better regulation, and a reduction in exciting current, all inportant characteristics.

So radical were the changes made at that time that a large proportion of the electrical fraternity were led to feel that further increases in efficiency and exciting current were impossible. Nevertheless, development of the type S transformers has continued to progress and several marked improvements have been recently announced.

It is the belief of the designers of this line of transformers that this improved shell type of construction cannot be materially improved upon for distributing transformers of the 2200 volt class. The success of the large number of transformers of this type now in service supports this view.

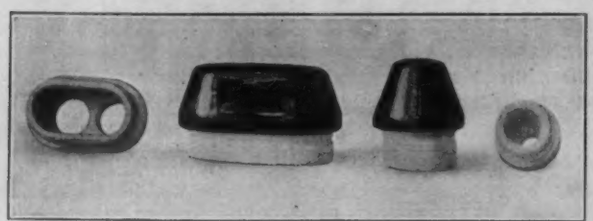


Fig. 2. Improved Transformer Bushings Showing Preventatives for Dust Collection.

The recent improvements have, therefore, resulted from improved materials and better mechanical design. The subject of insulation has been given special attention, as upon this the life of the transformer largely depends. The insulating materials now used are of better quality both mechanically and electrically, with the result that a further increase in efficiency and reduction of exciting current has been obtained. For example, the 7½ kva. type S transformer which formerly had an iron loss of 62 watts and copper loss of 125 watts, now has only 57 watts iron loss and 110 watts copper loss. The exciting current has been reduced from 2.2 per cent to 1.7 per cent, and the regulation at 100 per cent power factor improved from 1.69 per cent to 1.55 per cent. Other sizes show corresponding improved performance.

A very uniform temperature is maintained throughout the entire transformer and in no place does the temperature rise exceed 50 degrees under normal conditions. This insures long life and high all day efficiency.

In line with the question of insulation, the high tension coils have been further subdivided, to reduce the voltage between layers of the windings as well as between coils and thus relieve the strain on the insulation. A view of the improved coil is shown in Fig 1.

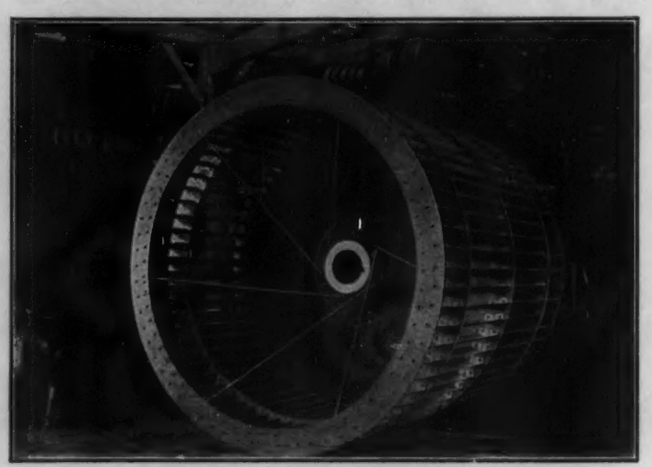
Slight changes have also been made in the terminal bushings to further prevent possibility of grounding to case due to the collection of dust between the bushing and the case and to still further make the siphoning of oil from the case impossible. The new bushing is shown in Fig. 2.

A highly flexible weatherproof cable is used for the leads of the type S transformer. These leads are rubber insulated with a grade of rubber that would deteriorate very slowly if exposed to the weather; the rubber insulation is protected by a braided covering. This cable meets the rigid new requirements of the National Board of Fire Underwriters, which some of the cables now used on transformers do not.

The manufacturers of the type S transformer announce that they do not believe a transformer incapable of further improvement will ever be built, and that therefore it is their intention to continue the development of this line, even though they consider it already ahead of anything on the market.

VENTILATION PENNSYLVANIA RAILWAY COMPANY, BALTIMORE AND POTOMAC TUNNEL, AT BALTIMORE, MARYLAND.

The Pennsylvania Railway Company are installing a very large ventilating plant in one of the tunnels under the City of Baltimore. This tunnel has a length of 4963 feet with a cross sectional area of 432 sq. ft. The crown of the tunnel is

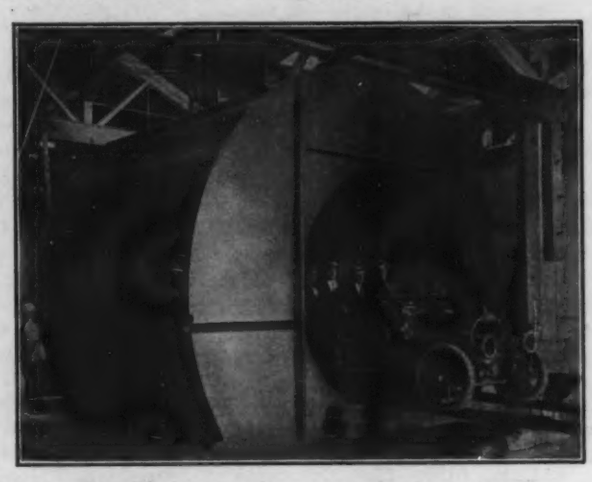


Wheel of Sirocco Fan for Ventilating Baltimore & Potomac Tunnel.

19 feet high above the rails at the portals and the cubic feet of space from end to end amounts to 2,150,000.

The fans discharge downward through the floor into a chamber surrounding the upper part of the tunnel, the air being discharged from the chamber through a long tapering nozzle carried around the entire perimeter of the tunnel above the tracks in such a way as to direct the flow of air forward much the same as it would from an injector.

The fan wheel or impeller is 10½ feet in diameter and breadth, with a division plate, dividing the breadth of it into two halves, air entering from both sides. The relative proportions of this fan wheel is more readily apparent in the photograph where it is shown near the end of a box car. It will be noticed that it is about as high as the car, is 50 per cent wider and almost half the length of it.



Housing of Sirocco Fan for Ventilating Baltimore & Potomac Tunnel.

Only one of these fans is intended to be in operation at a time, the other being held in reserve for use in case of accident.

It was determined that this tunnel would require 450,000 cu. ft. of air per minute. This volume will produce a velocity through the tunnel of 1040 feet per minute or at about the rate of 12 miles per hour and will give an air change in 4¾ minutes, or, in other words, a unit of volume starting at one end will be only 4¾ minutes in passing through the tunnel.

When a train is going through the tunnel in the same direction as the air current, the available area for the passage of air being so greatly reduced, causes the air to travel much faster than the train; hence, any smoke from the locomotive is pushed before the train so fast as to give the engineer a clear view of the tracks, thereby enabling him to easily stop the train in time to avoid accident. The movement of air is so rapid as to make it perfectly comfortable for the passengers and train crew at any and all times, even if the train comes to a dead stop for a prolonged period.

While these fans are of huge proportions, yet they are small as compared with the dimensions of an old-style fan to do the same work, such as was commonly used for the same purpose before the "Sirocco" fan was invented.

Charles S. Churchill, chief engineer of the Norfolk and Western Railway Company, Roanoke, Va., designed the plant where these fans are to be installed, as he has several others, notably the Galetzin, Bid Bend and Elkhorn tunnels for the Pennsylvania Railway and the Norfolk and Western Railway. Previous to the installation of the ventilating plant at the Elkhorn tunnel at Coaldale, W. Va., on the Norfolk and Western Railway, it required from 17 to 55 minutes to clear the tunnel of smoke; the temperature inside the tunnel became about 30 degrees higher than the outside temperature after a train had passed through, and during the four years immediately preceding the installation of the ventilating plant, twenty-six men were asphyxiated in the tunnel.

After the installation of the ventilating plant, smoke would appear at the portal ahead of an engine two minutes before the train appeared and in less than a minute after the engine had passed out, even the steam had vanished from the roof where it usually clings so persistently.

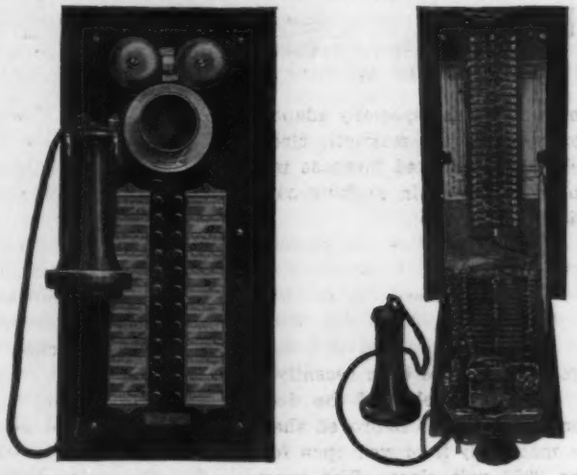
Eastbound, trains which have to run up grade now, pass through the tunnel in 5½ minutes, and one train can follow the other as rapidly as it is safe to place them, regardless of the tunnel.

The installation of this ventilating plant made it possible to increase the load of eastbound trains about 100 tons, saving four eastbound trains per day on a run of eleven miles, which represents a net saving over and above the cost of operation of about fourteen hundred and forty-six dollars per month, or from seventeen to twenty thousand dollars per year.

The "Sirocco" Fan, made by the American Blower Company of Detroit, Michigan, and Troy, New York, is unquestionably the greatest advance made in air-propelling machinery in the last century, and of itself has attracted more general attention to the use of fans for ventilation and the benefits to be derived from good, fresh, pure air than probably any other agent, because of the small size of the fan for a given duty, its remarkably high efficiency and very quiet operation.

A NEW METAL FLUSH TYPE OF INTER-PHONE SET.

The Western Electric Company has added to its many types of inter-phones a new metal flush set, which on account of its handsome appearance, convenience of installation, compactness and general efficiency, represents the highest type of inter-communicating telephone for residence work. This set, known as the No. 1335-type, is made in capacities for 12, 16 and 24 stations, the one shown in Fig. 1 being a 24-station type.



No. 1335-F Inter-phone Set. Interior and exterior Views.

One of the features of this set is the metal outlet box which is separate from the set and can be built in the wall while the house is in process of construction. All the apparatus is mounted on a face plate, which is hinged at the bottom so that connections in the outlet box are easily accessible when the face plate is removed.

While the set is compact, it is not crowded, and a concealed binding post receiver adds to its neat appearance. Conversations between pairs of stations at the same time are perfectly quiet, that is, there is no evidence of the annoying interference known as cross talk. As many conversations can be carried on at once as there are pairs of stations.

By winding the coils of the vibrating bells to 10 ohms, the current necessary to ring long or short lines is more nearly equalized. A high resistance transmitter and receiver are used with the set which insures low battery consumption.

NEWS NOTES

FINANCIAL.

MYRTLE CREEK, ORE.—The city is to bond itself to the extent of $20,000 at the next meeting of the council to provide funds for the laying of a pipe line to a stream two miles from town, where a dam is to be constructed to supply the city with water.

SAN FRANCISCO, CAL.—H. P. Wilson, secretary of the Great Western Power Company, and of the California Electric Generating Company, a subsidiary company, has called meetings of the stockholders on October 26, at room 1012, Shreve Building. An increase in the capitalization of the parent company from $25,000,000 to $27,500,000 will be considered. A proposition to make dividends on the stock of the subsidiary company cumulative after January, 1912, will be brought before the stockholders, as also the desirability of a contract for power with the City Electric Company and the guaranty by the California Electric Generating Company of the payment of the interest upon $1,700,000 bonds of the City Electric Company.

SAN FRANCISCO, CAL.—A suit to bring about the reorganization of the San Francisco, Vallejo & Napa Railroad Company has been filed in the office of the county clerk of Napa County, by the Mercantile Trust Co. of San Francisco. The complaint says that on October 22, 1906, the defendant executed a mortgage to the British American Trust Company, as trustee, to secure the payment of 1500 bonds for $1000 each. Later the company defaulted on its interest, and on July 13, 1911, the Mercantile Trust Company was chosen as a new trustee of the mortgage. The electric railroad company has filed its consent to the proceedings of foreclosure. The reorganization will leave the company in better financial condition than before.

LOS ANGELES, CAL.—A meeting has been called for October 9 by Chas. Forman secretary of the Pacific Light & Power Company, at which the stockholders of the company will consider the issuing of bonds to the amount of $35,000,000 in addition to its outstanding issues of $5,000,000 in collateral trust 6 per cent 5 year gold bonds. Of this $35,000,000 there will be set aside $9,015,000 to take care of the underlying bonds of the corporation and $3,000,000 authorized to protect the holders of the bonds of the Southern California Gas Company, a subsidiary concern. Bonds to the amount of $10,000,000 have already been contracted for in New York to carry on the construction of the great plant on Big Creek, and in the construction of the distributing plants in the San Joaquin Valley and other portions of Southern California. The remainder of the bonds, nearly $13,000,000, will be sold and the proceeds expended in future extensions, which the corporation is planning. The plant under construction on Big Creek will develop 80,000 h.p., with an ultimate capacity of 150,000 h.p. by enlargements at a later date.

ILLUMINATION.

LA MESA SPRINGS, CAL.—The San Diego Land Improvement Company is planning to establish a gas plant at Encanto to make gas from gasoline and distribute it in mains sufficient to supply residents on the tract.

RIVERSIDE, CAL.—A. N. Kemp, second vice-president and controller of the Southern California Gas Company, states that gas pipes will be laid soon. The plan in contemplation is to belt the city with high pressure pipes and feed from them into low pressure mains through automatic regulators.

ELLENSBURG, WASH.—Ordinances ordering a municipal water system for Ellensburg and calling for an election for the purpose of ratifying an issue of $110,000 of electric light bonds has been passed by the council.

VICTORIA, B. C.—The city council will shortly formulate plans for extending the cluster lighting system on View street. Provisions will be made for laying conduits for arc lighting wires in the James Bay district.

SACRAMENTO, CAL.—Work of laying its cross-city conduit which will run from Seventh and M to Seventh and I streets, will be commenced immediately by the Citizens Light & Power Company, according to President George W. Peltier. He says: "We are going to use the latest type of steel conduits and will bury them about 4½ feet under the surface. The poles in the resident district also, will be placed in alleys. We now have a sub-station, at Eighth and R streets, which regulates the amount of power we receive from the station at Brighton. Power will be conducted from the Eighth and R station by the Seventh street conduit and from this main line wires will radiate east and west through the alleys into all sections of the city. We are already supplying many with power along R street."

INCORPORATIONS.

SALEM, ORE.—The Hermiston Telephone & Electric Company, Hermiston, has been incorporated with a capital stock of $7000.

BAKERSFIELD, CAL.—The Bakersfield Gas & Electric Light Company has been incorporated by H. A. Jastro, H. A. Blodget, L. C. McAfee, L P St. Clair, and C E. Jewett, with capital stock of $100,000.

BOISE, IDAHO—Articles of incorporation have been filed for the Mountain States Telephone & Telegraph Co., E. B. Field, Pres., capitalized at $50,000,000. This company is a consolidation of the Colorado Telephone Co. and the Tri-State Telephone & Telegraph Co., and will carry on a general telephone and telegraph business in Idaho, Montana, Arizona. Colorado and other states with principal offices at Denver, the lines to extend from that city to territory named. King Cobbs, 511 Bannock street, Boise, Idaho, is the Idaho agent.

TRANSMISSION.

WASHOUGAL, WASH.—Sam Samson has applied for a franchise to extend his high voltage electric wire through this town and county to Vancouver, a distance of 60 miles.

KELSEYVILLE, CAL.—James A. Gunn, Jr., has applied for a franchise for a period of 50 years, to erect and maintain poles, upon county roads for the purpose of transmitting electric power and heat.

LOS MOLINOS CAL.—A representative of the Sacramento Valley Power Company is making a thorough canvass of the farming district around this city for the purpose of making contracts for light and power with the farmers. It is understood that the Northern Electric Company will soon have a man in the field for the same purpose.

COLUSA, CAL.—That the people of Williams will have electricity for light and power shortly is now assured. The

Supervisors have granted a franchise to the Northern California Power Company, and E. V. D. Johnson, manager of the company, was in Williams recently making necessary arrangements for the completion of the line to that town. The power company will have its main office in Colusa County and will also have an electrical supply store where electric fixtures will be demonstrated to the public. Jerry Myers, of Willows, who has been superintending the work in Williams, will be the local manager in the latter town, it is said.

SACRAMENTO, CAL.—What is considered an attempt to gobble up the entire water supply flowing in or out of Cowshed lake, Modoc County, was unearthed yesterday by the conservation board of control in the water filing of George B. Ayers. Ayers' filing is for 5,000,000,000 cubic feet of water, which is a record breaker for the State. The filing was made Feb. 7, 1911, before the conservation laws went into effect. Whether Ayers intends to use the water for irrigation purposes or is to hold it for speculative play is a question the board expects to determine.

LONG BEACH, CAL.—All preparations are practically completed for the first run of the initial unit of the Southern California Edison Company's new power plant in process of installation on Long Beach Harbor. All the machinery is in working order except some minor parts, which are essential, however, to its operation, such as disconnecting switches. Construction is rapidly proceeding upon additional units to go into commission as soon as they are completed. Each is of a capacity of 12,000 kw. and an official of the company stated this morning that no decision as to the limit in their number has been reached the site and franchises secured being of such proportions as to permit of the erection of a plant sufficient in size to meet all the power demands of Southern California.

NEVIS, CAL.—The Great Western Power Company on the north fork of the Feather River, will build at a point two miles below the Big Meadows, in Plumas County, one of the most expensive dams in the country for the storage of water in the Big Meadows, which is the headwaters of the North Fork of the Feather River. By building this great dam the company will overflow about 25,000 acres of land at an average depth of 25 feet. By tests made with a diamond drill at this point it is found that the company will have to make an excavation about 500 feet below the surface to reach a solid foundation from which to commence this work. It will be seen then that most of this great piece of work is to be below the present surface, the dam itself above the surface being only 150 feet high. It will be many hundred feet long on top. The company has been very active this year in the preliminary work leading up to the road work construction. Several hundred men are now employed in this preliminary work.

SACRAMENTO, CAL.—Arrangements for the examining of applications for the appropriation of waterpower in accordance with the new law have been made by the Conservation Board of Control. The members present were C. D. Marx, S. C. Graham and State Engineer N. Ellery. Secretary Louis R. Glavis said that the new blanks on which the applications are to be made will be ready for use within ten days. Glavis stated that ten applications for the appropriation of waterpower had already been made. One of the first that will be acted upon is that of Los Angeles city in connection with the $23,000,000 Owens River aqueduct project. The application made in behalf of Los Angeles by Chief Engineer William Mulholland asks for waterpower appropriation for 1500 inches on the Cottonwood Creek, 2078 feet of head water for Cottonwood Creek power house, No. 3, 2197 feet for Cottonwood Creek power house, No. 2 and 1218 feet for Cottonwood Creek power house, No. 3. The application also includes data regarding the construction of the two gigantic reservoirs included in the general project.

TRANSPORTATION.

BOISE, IDAHO.—The Nampa & Caldwell Electric Company will construct a railway. A contract will soon be let.

LOS ANGELES, CAL.—The work of constructing an electric line to El Segundo will be started within a few days. This is the new Standard Oil town.

RAYMOND, WASH.—Sanderson & Porter, contractors, have started construction work on an electric railway between this place and South Bend. The right of way is being cleared.

CHICO, CAL.—The Board of Trustees has passed an ordinance granting permission to George E. Springer to construct and operate a railroad over certain streets in the city of Chico.

LOS ANGELES, CAL.—Contracts will be let next week for building an electric railroad connecting San Bernardino and Riverside, by the Pacific Electric Company. This line will be about 7 miles long, but includes heavy construction and a long trestle bridge over Santa Ana River. The line has been surveyed and will be built from San Bernardino to Rialto.

VANCOUVER, B. C.—The Canadian Electric Construction Company has applied for a franchise to construct a tram line across Stanley park. The proposal was referred to a commissioner, who will have power to act.

EUGENE, ORE.—Mr. Kruttschnitt, head of the departments of maintenance and construction of the Harriman lines, states that there is every indication that the Southern Pacific Railway will electrify its west side lines into this place via the town of Corvallis.

SOUTH PASADENA, CAL.—Work is expected to start within a few days on the new freight and passenger station which the Pacific Electric Company will erect on Mission street, just east of Fair Oaks. It will be of Mission style architecture and cost $10,000.

SANTA BARBARA, CAL.—San Luis Obispo officials have granted Walter Gould Lincoln of Los Angeles, a franchise for the construction of an electric road from San Luis Obispo to the coast. This will probably be extended eastward through the mountains to Bakersfield and Fresno.

PETALUMA, CAL.—The Petaluma & Santa Rosa Railway Company has commenced a suit in the Superior Court of Sonoma County against Henry Poehlmann, Geo. P. McNear and others to condemn a right of way for that road along the west side of Petaluma River and south from the city.

PORTLAND ORE.—Two electric lines may be operating between Portland and Eugene before the end of the coming year—one an extension of the Oregon Electric and the other an extension of the Southern Pacific's Corvalis line. The Oregon Electric project already has been planned and actual work on its construction awaits only the arrangement of details. While the Southern Pacific has not officially announced its intention to connect Eugene with Portland by means of an electric line every indication points in that direction and actual developments of the last few months seem to bear out the theory.

SAN FRANCISCO, CAL.—Work has started on the east portal of the Oakland-Antioch Electric Railway Company's tunnel connecting Alameda County with Contra Costa county. The west portal will open into Oakland at a point within 200 yards of the easternmost limits of the city. Completed the tunnel will be about 4000 feet in length. At the present time the Oakland-Antioch has trains running into Walnut Creek from Bay Point in Contra Costa County. Rails are

being laid into Lafayette. It is from the latter place the last lap of the electric railway is being run a distance of 18 miles. When completed the Oakland-Antioch will have a trackage of 50 miles, the distance from Bay Point into Oakland.

TELEPHONE AND TELEGRAPH.

NEWPORT, WASH.—J. W. Fisher, manager of the Interstate Telephone Company, is applying for a telephone franchise in this city.

TRUCKEE, CAL.—The telephone lines of the Pacific Telephone & Telegraph Company between Camptonville and Loyalton will be rebuilt.

BOISE, IDAHO.—A. R. Johnson has been appointed as Idaho agent and Lewiston as headquarters in Idaho, of the Pacific Telephone & Telegraph Company.

ALICEL, ORE.—Cove and Alicel have had a meeting for the purpose of formulating plans to organize a co-operative telephone company in Wallowa and Union counties.

BELLINGHAM, WASH.—The Farmers' Mutual Telephone Co. has opened offices in the Daylight building. The local office will handle all the company's outside business.

KALISPELL, MONT.—The Columbia Falls Telephone Association, capitalized at $40,000, has been incorporated by C. C. Miller and H. E. Kennedy. The company contemplates the installation of telephone lines all over this county, with headquarters at Columbia Falls, Mont.

ABERDEEN, WASH.—Plans and specifications for the new building to be erected by the Pacific States Telephone & Telegraph Company, on Market street, have been completed by Architect Watson Vernon. This is to be a three-story brick and concrete building, to cost $30,000.

MEDFORD, ORE.—C. H. Moore, of Portland, district superintendent of the Pacific Telephone & Telegraph Company announced that his company will, within a short time, start work on an additional cable estimated involving an expenditure of between $15,000 and $20,000.

WATERWORKS.

BURLINGTON, WASH.—Burlington is to have a water system. A pumping plant is to be installed.

BREWSTER, WASH.—This place at a recent election voted bonds for the construction of a water system.

FALLS CITY, ORE.—This place will soon vote on bonds for a $5000 bond issue, to extend the local water main system.

ELLENSBURG, WASH.—A special election was held September 4th to decide on a $150,000 bond issue for the construction of a municipal water system.

CENTRALIA, WASH.—Meetings are being held in an endeavor to further the interest of establishing a gravity water system to serve this place and Chehalis.

GLADSTONE, ORE.—The election providing for the issuance of bonds in the sum of $20,000 for the construction of a water system has been carried by 28 majority.

ELMA, WASH.—Citizens of Elma have petitioned the council to allow the citizens to vote a $10,000 bond issue for the purpose of extending and improving the water system.

CARLTON, ORE.—An election has been carried in favor of bonds in the sum of $40,000 for the purpose of constructing a new water system. The water will be brought from Panther creek. A fall of 200 feet can be secured.

TENINO, Wash.—The City Council has granted a franchise to the Tenino Light, Power and Water Co. to erect, maintain and operate a system of waterworks for the town.

ASOTIN, WASH.—The council has passed an ordinance providing for the issuance of bonds in the sum of $35,000 for the purpose of constructing a water system according to plans by C. H. Green, on file in the office of the town clerk.

DORRIS, CAL.—Notice is given by the town of Dorris, County of Siskiyou, State of California, that it will receive sealed proposals to build the Dorris Water Works system up to September 4, 1911.

WAPATO, WASH.—This city is to have a water system according to plans filed in the office of the Auditor of Yakima County, also in the office of the town clerk. Pipe ranging in size from 6 to 10 inches; estimated cost $17,000.

OAKLAND, CAL.—The first work of laying the 6-inch water mains in the annexed district west of Fitchburg was started yesterday by the Union Water Company, when a force of men were set to work distributing the mains along Peralta street.

MARSHFIELD, ORE.—At a meeting of the water commissioners of Marshfield and North Bend, Stannard & Richardson of Portland were engaged to prepare plans and estimates of the cost of a municipal water system for the two cities.

SAN FRANCISCO, CAL.—Engineers Sloan & Robson, 802 Nevada Bank Building, have prepared plans for the drilling of two 12-inch wells which are to form a part of the city water system of Tracy. Bids for this work were opened on August 31.

HERMINSTON, ORE.—An election has been carried in favor of the issuance of bonds in the sum of $25,000 for installation of a water system. The system calls for a 250,000 gallon reservoir 140 feet above the city, the water to be brought down in a 12 inch main.

PILOT ROCK, ORE.—Representatives of the C. H. Green Company of Portland, Ore., visited Pilot Rock and after a short consultation with members of the council entered into a contract with the city for a complete survey and estimate of the cost of a waterwork system.

ASOTIN, WASH.—The council has passed an ordinance providing for the construction of a waterworks system for Asotin to cost $35,000, payment to be made by issuance of a $35,000 bond issue, denomination of $1000, payable 20 years from date, interest 6 per cent per annum.

WENATCHEE, WASH.—O. A. Hoag has started excavating at the lower end of Lake Chelan, preliminary to his project to develop the water power of Chelan Falls. A contractor and crew will soon lay pipe and the town of Chelan has granted right of way for this purpose.

TACOMA, WASH.—City Electrician B. W. Collins states that the local light and power lines will have to undergo a complete change and be completely re-organized to care for the electricity to be developed by the Nisqually municipal power plant, which will be completed July, 1912.

VANCOUVER, B. C.—Upon the recommendation of the city engineer, the city of Vancouver is within the next six weeks to lay a sixth additional 12-inch main under Burrard Inlet at the First Narrows, the pipe having been ordered and the location for the main selected. It is proposed, also, to provide another intake at Capilano Creek and more mains across the inlet, although a large reservoir at Little Mountain will be ready to be cut into the system of the city within the course of a year, greatly increasing the supply of water.